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The Growth of a Great Industry. THERE are very few of our readers, we think, who will not be interested in the description and illustrations given this week, in our special Supplement, of the Edison Machine Works, at Schenectady, N. Y. From time to time we have been able to present information, more or less full, as to the growth of various electrical arts, but this is the first occasion upon which the great industry of dynamo building has received adequate treatment. Outside electrical circles there is still wanting an appreciation of the magnitude of the enterprises to which the electric light has given rise, and we take no little pride in being thus able to illustrate one example of the manner in which the work that this journal has been identified with has won place and prominence.

A New Source of Power. OUR columns this week again demonstrate that what was an experiment but yesterday is the actual practice of to-day. We show the remarkable installation at Yankton, Dak., in which an artesian well is utilized as a source of power for driving the dynamos of an electric light station. In localities where such wells are available, the business of electric lighting ought certainly to be very inviting, as the success in the one instance cited is sufficient to warrant the sinking of another well to increase the power.

Shallenberger's Alternating Current Meter. MANY ingenious and novel forms of apparatus have recently been designed for the purpose of measuring the quantity of alternating current passing through a circuit, and the number is being constantly increased. Thus we described last week the new instrument designed for that purpose by Prof. Forbes, and this week we now illustrate another, the Shallenberger, of no less interesting character. Mr. Shallenberger's meter is a special form of alternating current motor, and as such the principle may possibly be applied to the construction of a machine for developing power on a larger scale than that required for the purposes of a meter.

Alternating Current Litigation. WE gave last week a short abstract of the decision rendered by Judge Colt in the case of the Westinghouse Company against the Sun Electric Company for infringement of the Gaulard-Gibbs patent, and this week we are enabled to present to our readers the full text of the decision. From this it will be noted that Judge Colt decides, in effect, that the Gaulard-Gibbs patent is limited to the application of transformers in series; and on that ground the Sun Company, which employs transformers in parallel, does not infringe the patent. In all probability this decision will be appealed from, but as it stands it puts the alternating system of distribution, as actually practiced, on a different footing from what has heretofore been the case. We may expect indeed some curious developments in this direction in the not distant future, as the patent for distribution by transformers in parallel is still, we believe, in the Patent Office, where it is being claimed by a number of inventors.

The Coming Conventions. NEXT week the meeting of the National Electric Light Association will be held in this city at the Hotel Brunswick, and the week following the National Telephone Exchange Association will convene at the same place. Undoubtedly the electric light convention will be largest ever held representing that industry, while General Barney, in his secretarial bulletin, says of the telephone convention that it will be of unusual interest both as to attendance and as to the importance of the papers read. Altogether the coming fortnight will be a memorable one, and if our readers have a little spare time then they cannot put it to better advantage than by spending it among the men who are doing the work in the latest and largest applications of electricity. Several valuable papers have been promised for the electric light convention, and the discussions will be useful to all who listen to or participate in them. The National Electric Light Association has a praiseworthy record of performance, and it deserves the active support of all whose interests it aims to promote and protect.

Animal Electricity. WE would call special attention to the remarkable researches and results obtained by Prof. D'Arsonval, on the function of animal movement as affected by the muscles. M. D'Arsonval shows in effect, what has been long suspected, that the action of muscles generates currents due to the variation of superficial tension created thereby, and that, vice versa, the variations of superficial tension may create contraction and elongation, depending, upon the state of the charge. On this theory he explains in a simple manner very many of the phenomena connected with muscular animal motion, and suggests the very apt analogy that the muscles and nerves constitute a form of electric motor of the most efficient character, and that the heat produced by such motion is not, as heretofore considered, the source of power, but is the residual or waste product and analogous to the waste caused by heating in ordinary electric motors. These researches must be considered as among the most important which have been made on this subject in recent times.

A Mysterious Document. COPIES are being freely distributed in this country and abroad of a most remarkable circular bearing the name and address of Shippey Brothers, Limited, of London, England. The circular states that at a "convention of patent experts recently held at Washington, D. C., appointed by the trade in order to discuss the validity of certain claims in dispute in connection with and relating to incandescent lamp manufacture," an award was given to the firm placing "an absolute monopoly" in its hands "for the supply of fancy lamps and for all lamps of 100 candle power and upwards for incandescent lighting." This wonderful convention is said to have passed upon the validity of "the Zanni-Shippey Patents, No. 5,955, of 1883, and No. 11,802, of 1887," and "also gave a certificate as to priority of invention for fancy striped and colored lamps, etc." Altogether, the circular is a most mysterious document. We have never heard of this convention of patent experts, and painstaking inquiry fails to discover anybody else who has. Who were these "experts," and when did they meet? And if they met, who gave them authority? Nobody in "the trade" knows anything about them, and certainly nobody in the trade had any power to usurp in their behalf, or with their aid, the powers of the Patent Office and the United States Courts. Even if there was such a convention—which we doubt—and even if these experts did give awards and certificates—which we do not believe—what earthly value would such awards and certificates have? The circular is in itself a jumble of bad grammar and inconsequent reasoning, and unless the authors can verify their statements they will find there is but one opinion as to their motive and object.

The Value of Inventors. A VISIT to such an establishment as we have described in our Supplement this week must convince any one that for a young industry electric lighting is already most stable, vigorous and prosperous, and it must inspire confidence not only in the welfare of electrical applications now familiar, but in the success of those hardly yet known. Ten years ago electrical industries of this size and importance were undreamt of; to-day they employ millions of capital, and mark the latest advances of science and skill. Ten years ago Mr. Edison might well have been content to rest his fame on what he had done in the fields of telegraphy and telephony; but to-day, as he looks over all the new great industries with which he is connected, he might be pardoned if he found in them some consolation against the depreciating criticism which has gone so far as to deny him any inventive merit at all. There is unfortunately in some quarters a tendency to belittle the worth of the inventor to society. The philosophy of it is all wrong, but we are informed, nevertheless, that the "great man theory of inventions" is fallacious, and that all our modern gains in the arts are due to something not ourselves which makes for invention. This is a new law of evolution to us, and certainly would render the task of inventing very easy to everybody except the inventor. For ourselves we believe that the more it honors and rewards the inventor, the more our civilization will be advanced, and the more instances it will have of the kind we have drawn attention to of the development of grand and beneficent industries. A great inventor may suffer not less from the laudation of his friends than from the iconoclasm of the theorists who would claim all his ideas as common property; but after all his work will stand as his, and he will be judged by the record of actual accomplishment, before which all that is derogatory, depreciative and destructive will, in time, fade away.

The Paris Exposition of 1889. WHAT promises to be one of the best exhibitions given in modern times is that now rapidly progressing towards completion at Paris. The French Government has spared no expense to render the International Exhibition of 1889 the best that has ever been given, and the arrangements which they are making will bring electricity, and electric lighting especially, prominently to the fore. Unlike most exhibitions in the past, the Paris Exhibition will be open at night, and it is needless to say that the illumination will be exclusively carried out by electricity. For this purpose the French Government has put the electric lighting in the hands of a syndicate which has undertaken to furnish all the light required, and which will receive as a remuneration one-half the receipts of each evening. Thus, it will be seen, exhibitors of electric lighting apparatus will not only obtain the benefits to be derived from the exhibition itself, but they will actually receive compensation, which, it is fair to estimate, will far outweigh all the cost of the installation. By the terms of the agreement with the government, the syndicate is not an exclusive one, but any company may obtain admisson to it and do a part of the lighting. It is estimated that the public lighting alone will require an illumination equal to about 1,500,000 candles, for which 3,000 h. p. will be provided, and this does not include private lighting, which may amount to as much more. The representative of this syndicate, M. Abdank-Abakanowicz, has just arrived in this country for the purpose of offering a part of this lighting to American exhibitors; and as the time for joining the syndicate expires very shortly, it would be well for our American companies to look up the matter at the earliest possible moment. There is here an excellent chance to demonstrate the progress made by electricity in America, and at the same time to obtain what promises to be a handsome recompense for the outlay involved. The expenses, by the way, will be reduced to a minimum when it is considered that the United States Government has undertaken to furnish transportation both ways for all apparatus which may be required for the exhibition, and that there will be no charge made for floor space. We hope that with these liberal inducements, American exhibitors, both in the field of electric lighting as well as in all other electrical branches may see their way clear to participation in the coming exhibition. The French Government exerted its utmost in the support of our own Centennial of Liberty, and we owe France a debt which we can now repay at her Centennial.

NEW BOOKS.

FORTSCHRITTE DER ELEKTROTECHNIK. Edited by Dr. Karl Strecker. Vol I., Part 4. Berlin, 1888: Julius Springer.

This number constitutes the fourth and last part of the complete index to the electrical literature of the world during the year 1887. We can only repeat what we have already said in praise of this work, the value of which has been still more increased by two elaborate indexes of subjects and authors.

On the Relation between Animal Electricity and Surface Tension.

In a note on this subject by M. D'Arsonval, presented by M. Brown-Séquard to the French Academy of Sciences, the author expounds some novel ideas on animal electricity. Electric currents of animal origin may be divided into two quite distinct classes: First, the currents of rest, and second, the currents of action or movement. In the present note, the author treats exclusively of the latter, namely, the currents of action.

For a long time M. D'Arsonval has considered that the cause of this current ought to be attributed to the relation which exists between electrical phenomena and superficial or surface tension. This law, the knowledge of which we owe to the remarkable work of M. Lippman, seems to him of very great importance in physiology. It may be stated as follows:

The superficial tension at the surface of separation of two liquids is a function of their difference of potential; or, inversely, *if the surface of separation be deformed or displaced by mechanical means, there is produced a variation of potential, the direction of which is opposed to the continuation of the movement.* M. Lippman has demonstrated this property for water and mercury by very simple experiments. M. D'Arsonval in 1878 recognized that the same action takes place for liquids and organic tissues. He has tested this fundamental experiment by a method which has the advantage of giving a physical conception of the muscular fibre and of the electric organ.

The apparatus consists of a tube of rubber *A B*, Fig. 1, which is divided off into a series of compartments by porous discs of wood or pipe-clay, upon which the rubber is firmly fastened. Each compartment contains a layer of mercury, upon which is placed a second layer of acidulated water. Each end of the tube is connected electrically with an indicating apparatus, such as the dead-beat galvanometer of Deprez-D'Arsonval. A weight is suspended at *B*.

When the apparatus is at rest no current is manifested, but if the weight be moved up and down, so that the tube assumes successively the form *A B* and *A' B'*, Fig. 2, the galvanometer is traversed by alternating currents, the intensity of which is proportional to the number of compartments in the tube. The law of M. Lippman easily explains the phenomenon.

This arrangement is reproduced in almost identical fashion in the muscular fibre and in the prisms of the electric organ. It suffices, in fact, to replace the mercury by a contractile substance, such as protoplasm. The beautiful researches of Renvier have shown that the above two parts are formed, in reality, of superposed layers alternately liquid and protoplasmic, and that they consequently fulfill all the conditions of the experiments described above. If that is the case, one ought to be able to obtain electric currents in mechanically deforming or displacing the muscle of the electric organ. Further, the direction of these currents ought to vary according as the deformation takes place by pressure or by tension. M. D'Arsonval has shown that these phenomena take place conformably to theory. If we take two muscles which we connect by the prolongation of their respective ends, and excite the nerve of the first, it contracts and presents the well-known classic negative oscillation. The second nerve, on the contrary, is deformed by tension, and presents a positive oscillation.

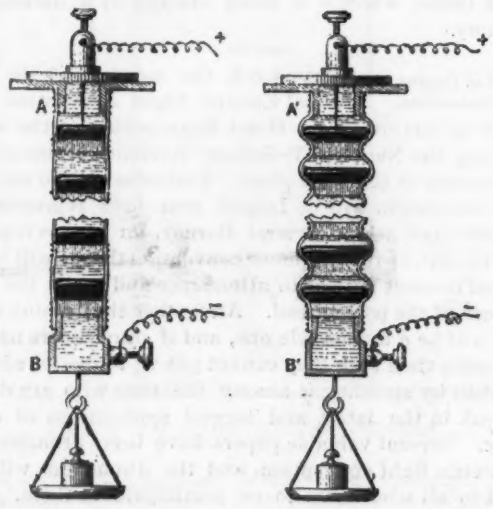
If we take a portion of the electric organ, and, by means of a conducting plate, put each face in connection with a galvanometer we obtain an inverse discharge when compressing the organ, and a direct one in extending it quickly. This result is absolutely unexplainable by a comparison of the electric organ to a battery or a condenser. It is quite simple on the theory of superficial tension.

The modifications in the surfaces of contact are not affected greatly by an external deformation either in the muscle or electric organ. It suffices that they be within the body of the tissue at the surface of contact of the organic molecules of different natures of which it is composed. This fact is well shown by the following experiment by M. Renvier. The muscular fibre is stretched under a microscope, and excited by a current. This fibre, rigidly fixed at its two extremities, cannot change its form externally, but internally it is quite different. Microscopic examination shows, in effect, that the internal changes between the thick (protoplasmic) discs and the clear discs of which it is composed, attain their maximum under these conditions, according to M. D'Arsonval's theory. This theory holds that the negative oscillation ought to be a maximum in a muscle which one excites, and which at the same time is prevented from shortening. The very old experiment of M. Brown-Séquard, which has remained unexplained, shows that such is the case. That eminent master has shown, in effect, that the secondary contraction which the excitation of a muscle engenders, is at its maximum when that muscle is prevented from shortening.

According to M. D'Arsonval, his theory explains the following phenomena by a physical cause: (1) The negative oscillation of a muscle which is allowed to shorten. (2) The negative maximum oscillation of a stretched muscle. (3) The positive oscillation of a muscle lengthened by tension. (4) The electric discharge of the torpedo, the gymnotus, etc. (5) The discharge in opposite directions which one obtains in mechanically deforming the electric organ. It explains also (6) why, in the discharge of the torpedo, the back is positive and the belly negative. (7) Why the discharge of the torpedo conforms to the same law, and is subject to the same influences as the muscular contraction, as has been so well established by M. Marey. (8) Why the negative wave of a muscle is propagated with the same speed as a muscular wave. (9) Why the excited muscular point is negative with relation to the muscular substance not excited. (10) How electrical phenomena can be propagated along a conductor with the speed only of a liquid wave. (11) How the variation of surface tension can explain the the movements of the protoplasm. (12) Why electricity is the most energetic excitant of the living substance. (13) Why the negative pole excites more than the positive. (14) Why we may maintain that the muscle is rather an electric motor than a thermic motor. There will thus be explained its high rate of efficiency, the heat being the residual product of the muscular contraction and not the source of that contraction.

Chemical Action in a Magnetic Field.

Since 1881, when Professor Remsen discovered that the deposition was affected by a strong magnetic field, experiments have been tried to determine the nature of the effect of magnetism on chemical action. The latest and most satisfactory contribution on the subject is that of Prof. H. A. Rowland and L. Bell, in the current number of the *American Journal of Science*. Their general method was to take two pieces of the metal to be experimented on, put them in circuit with a galvanometer, and immerse them in an electrolyte between the poles of a powerful magnet. The two pieces were covered with wax except at two opposite points, where they were bare, and by changing the shapes at the uncovered portions the condition of their surfaces with respect to the rate of change of magnetic force could be varied. For instance, in the first experiment that was tried pieces of iron were immersed in dilute nitric acid. One of the bare surfaces was flat, the other filed to a sharp point. If there was no deflection of the galvanometer when the circuit of the magnet was made, there was a sharp throw immediately on making the circuit, the needle then gradually returning to zero and going past to the other side. The throw was in a direction as if the sharp point was copper and the flat surface zinc. When the point was filed off, there was no throw. Thirty substances were tested as electrolytes. They in general showed the above phenomena, excepting that the acids which evolve hydrogen when electrolyzed showed it very feebly. Experimenting to find the cause of the gradual reversal of the deflection after the first throw, it was found that any agitation of the liquid produces the same effect, and that when diffusion was prevented, by using fine sand in the vessel or by using gelatine with the solutions, the first throw only remained. The small effect with the hydrogen-evolving acids is probably due to the mechanical protection of the point by the bubbles of gas. Cobalt and nickel were tried and found to give similar effects but smaller. From their experiments the authors come to the conclusion that the particles of magnetic material on the plates are governed by the general laws of magnetic attraction and are held in place against chemical action as they would be against a mechanical force. The rate of change of force at a point is, of course, greater than that on a plane surface, hence the metal on the point is to some extent protected against chemical action, and acts as the electro-negative metal in the circuit. The general rule stated is as follows: When the magnetic metals are exposed to chemical action in a magnetic field, such action is decreased or arrested at any points where the rate of variation of the square of the magnetic force tends to a maximum. The authors criticise a paper on the same subject by Professor Nichols, of Cornell, whose results are directly opposite to their own, as far as the two experiments touch. They claim that besides giving no explanation of or drawing any deduction from his results, he has in some cases mistaken disturbances for the real phenomena. The paper seems to explain the phenomena simply and naturally without the help of new relations or hypotheses.



FIGS. 1 AND 2.—EXPERIMENTS IN ELECTRIC PHYSIOLOGY.

The International Congress of Electricians 1889.

By a decree of July 16, 1888, the French Minister of Commerce and Industry has nominated the organizing committee of the International Congress of Electricians, which is to take place in connection with the Paris Exhibition in 1889. The committee comprises MM. d'Arsonval, acting professor at the Collège de France; Berger, ex-president of the Société Internationale des Electriciens; Boudet de Pâris, member of the Committee of the Société Internationale des Electriciens; Carpentier, vice-president of the Société Internationale des Electriciens; Cornu, professor at the Ecole Polytechnique; Gariel, vice-president of the Société Internationale des Electriciens; Hospitalier, professor de Physique et de Chimie at the Ecole Municipale; Joubert, secretary of the Société de Physique; Lemonnier, president of the Société Internationale des Electriciens; Mascart, professor at the Collége de France; Napoli, head of the Experimental Laboratory of the State railways; De Neville, head of the Central Laboratory of Electricity; Postel-Viney, president of the Chamber of Electrical Industries; Potier, professor at the Ecole Polytechnique; Raymond, director of the Ecole Supérieure des Télégraphes; Renard, director of the Government Workshops at Meudon; Sartiaux, chief electrician to the Chemins de Fer du Nord; Sebert, vice-president of the Société Internationale des Electriciens; Séligmann-Lui, secretary of the Société Internationale des Electriciens; Vivarez, secretary of the Chamber of Electrical Industries; together with MM. Bouilhet, Bourdin, Delahaye, Fontaine, Hillairet, Lippmann, Pellat, Picou, Touanne and Violle.

Sea Telegraphy.

BY W. A. R.

The recent Geiser-Thingvalla catastrophy calls to mind some of the attempts of our electrical inventors to provide efficient means for communication between vessels at sea, or between vessels and determined points along shore. So far as known to the general public, nothing of the kind is or has been put into practical use, and yet it is something that the traveling public, to say nothing of ship owners, would hail with great satisfaction and delight. Much of the nervousness and timidity of the "stay-at-homes" would be dispelled, and sea travel increased, if this one desideratum were in practical operation on sea-going vessels.

One great objection to this kind of apparatus as a means of safety, and which deters inventors from work upon the subject, is that the time would probably never come when all sea-going vessels would be provided with the apparatus. This appears true; and yet if all the steamship companies could and would equip their vessels for the purpose, a large percentage of the danger of collision would be averted. The regular line steamers usually travel over about the same course between ports, and the near approach of two ships of the same line would be made known to both vessels, whether it be daylight or dark, foggy or clear.

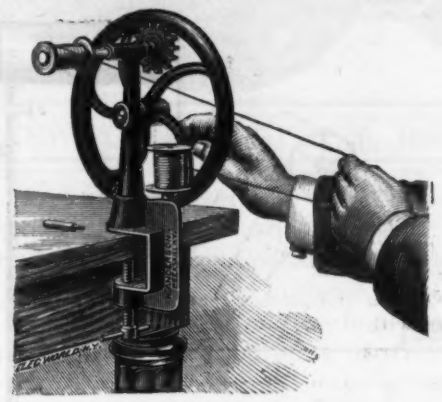
Among the apparatuses suggested, and in a few notable instances patented, are devices including an indicator, whose needle is deflected whenever the ship approaches another vessel carrying a similar apparatus. The indicator is sometimes supplanted by an alarm bell, or both are used. But whatever may be the indicating device, the utility and practical value is obvious to all. The lynx-eyed watchman on the "bridge" might be dispensed with, or at least a watchman having ordinary human eyes could fill his place. Newfoundland fogs might be travelled without apprehension of collision or necessity for slackened speed, and the comfort and safety of everybody would be secured. If the vessels of the Thingvalla Line had been equipped with some operative form of signalling apparatus of the kind described, it is probable that this great sacrifice of human lives would not have occurred.

This is another opportunity for our inventors and capitalists. Make these devices practical and put them into use, then reap the rewards and plaudits which are sure to follow.

A Handy Magnet Winder.

The handy magnet winder illustrated in the accompanying engraving is designed for use in telephone offices, laboratories, and wherever the occasional winding or rewinding of electro-magnets is necessary; while in workshops it is said to be much more convenient than a lathe for the purpose. It is light and simply made, and as it can be shipped by mail, even amateurs can afford to continue winding by hand.

The engraving represents a magnet being wound from a spool of wire which turns on a stud projecting from the clamp. A hub, like that shown lying on the table, is used to support the magnet, one end of the hub screwing on the spindle of the machine, the other end screwing into the thread in the magnet core. The spool and magnet hubs are interchangeable. To unwind a magnet it is placed on the stud shown occupied by the spool, and the latter is screwed onto the spindle. The operation of rewinding a magnet is clearly shown in the illustration. The winder is made by Mr. Homer Anderson, of Peekskill, N. Y.



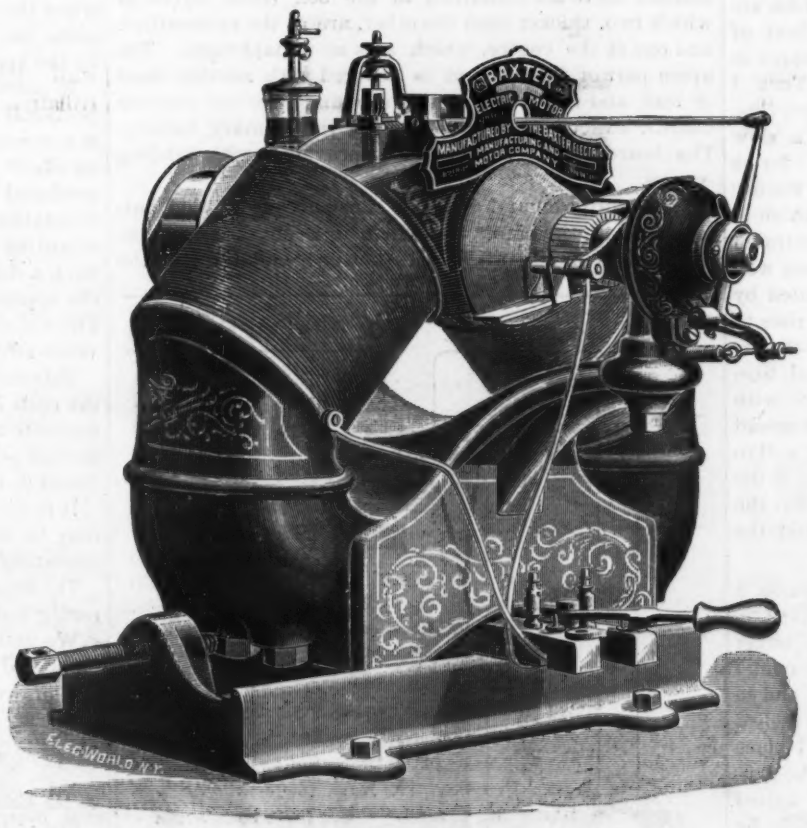
A HANDY MAGNET WINDER.

The New Baxter Motor.

We presume there are few, if any, of our readers who are not familiar with the appearance of the Baxter motor. Wherever it has gone, and through all the various and severe tests it has had to endure in supplying power for every conceivable kind of work from one-tenth to 20 horse-power, its satisfactory and efficient working has attracted the attention and called forth the praises of those who have seen its operation and of those who have discarded their engines for it.

The accompanying illustration shows the new design of the Baxter motor of the constant current type, which, like the constant potential machine, has undergone a slight change in appearance. In the old design, it will be remembered, the field magnets were made oval in cross section and were constructed of cast-iron. In the new machine an improvement has been effected by the use of a wrought-iron core. After long and careful experiments, the Baxter Company has succeeded in discovering a method by which the somewhat difficult feat of making a reliable and perfect weld or joint between the wrought-iron of the core and the cast-iron of the pole piece is successfully effected. The substitution of this wrought-iron core for the cast-iron affects the motor and its manufacture in more ways than one. First, the magnetic permeability of wrought-iron being almost double that of cast-iron, the section of core can be reduced in equal ratio, thus reducing the size of the motor; while the ends of the cores projecting for some distance into the cast-iron of the pole pieces tend to raise the saturation limit of these important parts of the machine.

Some minor alterations tending to increase the simplicity and the efficiency of working parts have also been made, which, with the use of the wrought iron core that insures more uniformity over the flaws and varying qualities incident to the use of cast-iron, go to produce a reliable and efficient motor.



NEW BAXTER MOTOR.

On the Proper Resistance of Telephone Conductors.

BY THOMAS D. LOCKWOOD.

I noticed in the columns of THE ELECTRICAL WORLD of Aug. 11, 1888, an article by David Brooks having the above heading, which advocates for telephony the use of small conductors.

From 1880 to 1885 I fought this heresy—for it is a heresy—almost alone. Fortunately I do not need to now, because every practical telephone manager now knows, and has learned by experience, that nothing can come of the use of small conductors except expense, discomfiture, and tremendous bills for repairs; besides hard-working lines.

Though a copper line of No. 16 gauge does indeed work well between New York and Philadelphia, there is no evidence adduced to show that it would not work better if it were larger. As a matter of fact, it has been proved that on longer lines a larger wire is necessary for the best work. The No. 16 Philadelphia line works well, not *because* it is small wire, but because it is a copper metallic circuit and well built, and in spite of the fact that it is a small wire.

It is true that electrostatic induction is a factor in the efficiency of telephone lines. It is not true that it is a more important factor than conductivity. If this were so, the smaller a wire would be, the better; and it is the experience of every one that has had any opportunity for observation that where Nos. 22, 24 and 26 B. & S. conductors are used in the telephone cables, they do not work satisfactorily, and that cables having No. 81 conductors do, other things being equal, work satisfactorily.

For the electrostatic capacity depends on the amount of surface exposed to induction; but the conductivity depends upon the sectional area; and while, when we double the diameter of the wire, we also double the circumference, it is undeniable that we quadruple the sectional area. Consequently we but double the capacity, while we quadruple the resistance.

The real truth of the matter is that we should consider the size, conductivity, capacity, and also the material of wire when choosing.

Copper is better than iron because it has a higher conductivity, a lower coefficient of self-induction, and is better than phosphor bronze because it is not so resilient, and has no tendency to run back and coil itself up, and also for the same reasons which recommend it in preference to iron.

Nos. 12 and 14 are better than No. 16, because their conductivities are higher in a much greater degree than their capacities are increased, and chiefly, because they are stronger.

It is more necessary to construct wires fairly large on the ground of building a strong line than for any other reason, and I say to all telephone men, Hold fast to the idea of never again stringing small wires. Let us put something up that will stay.

A Curious Telephone Trouble.

BY JOHN C. CRAWFORD.

I beg to lay before the readers of THE ELECTRICAL WORLD an occurrence which puzzled me for four hours recently.

On the morning of Aug. 4 about ten of our short lines in Reading, Pa., were found to be crossed with battery so so strong that none of the drops would remain up. Our linemen were sent out, but after going over the lines and reporting them clear, I went out with them, to test for the trouble.

Opening the lines at the subscribers' windows showed the lines clear; disconnecting the ground at the instruments also showed them clear, and opening the connection at ground showed it still clear. Hence the current had to come from the earth itself.

Although the wires were quiet, and no noise as of electric light was to be heard on them, still I was led to suspect that the trouble was "back current" from an incandescent system, and a visit to the Edison station confirmed my suspicion.

The electric light superintendent informed me that one of his circuits had been struck by lightning and there was a heavy ground on it which his men were searching for, and he hoped soon to report it clear. While waiting for him to clear it, I got the lines to work by putting resistance in the lines, so as to weaken the current. About 4 P. M. the ground was discovered in a saloon four squares away and immediately the lines cleared.

My view of the trouble is that while the circuit (electric light) was grounded, a very large amount of current was being forced into the ground, more than the poor earth in this town was able to absorb, and, finding the gas and water pipes to be a better conductor it took them and came back from them over our wires to the exchange.

The earth acting as a storage cell changed the current from a commutated one to a continuous, so that no noise could be heard on the lines, which would not be the case if we were crossed with or getting leakage from the Edison wires direct.

Only exclusive lines, *i. e.*, those with only one instrument, were affected; and only those lying between the exchange and the place where the light circuit was grounded; but no doubt many others were charged, although the current was not strong enough to throw the drops.

In this connection I may add that up to a few months ago, at indefinite intervals, every drop in the exchange, except those connected out of town, would fall, and an immediate search failed to show any battery on the lines, nor was there any lightning.

I always made it a point to ask of the electric light station if they noticed any trouble with their circuits, but they had not, until one day when the occurrence was repeated, and on inquiry the superintendent of the station told me he was examining the inside of a cylinder with the aid of a light, when he accidentally grounded the circuit, and on repeating this the drops all fell as before.

This city is built on solid limestone rock with only a thin skin of earth over it, and the strong Edison current cannot be absorbed by penetration, but must travel over the surface until it reaches softer ground.

I suppose in larger cities this "back current" has often been noticed, but there may be some other cities where it has given trouble.

I trust that others may profit by the publication of this.

Electric Cars versus Cable Traction.

It seems that the struggle for supremacy between electric and cable traction for street cars, although practically settled so far as the electric side is concerned, is still a subject for the advocates of the cable, who refuse to recognize defeat. We have so often pointed out the advantages of electricity that it is needless to recall them again here, and we only draw attention to the matter now in order to meet the remarks which have been made by an engineer at Kansas City, who, as one of his arguments, puts forth the fact that the electric current cannot compete with the cable, because the latter can pull cars up grades as steep as 18 per cent., a thing, he says, that the electric car cannot do. The criticism is perfectly correct, and we are not at all desirous to see any electrical engineer undertaking to run an electric railway on roads having 18 per cent. grades. It is obvious that in such situations the cable is in the right place, and is probably to be preferred to any other method devised up to the present time, so far as we know. But, as experience has demonstrated, grades up to 9 and 10 per cent., which are ordinarily as great as need be considered, can be successfully mounted by the electric car, and the economy of the system on such roads has long ago been proved to be greater than that which can be obtained from the cable. To argue, therefore, from an extreme and special case is avoiding the main question, and even if such arguments are successful for a time, they can only slightly keep back the final acceptance of electricity as the general source of power for street car traction.

Train Lighting.—A test of the Egan primary battery and its application to the lighting of passenger coaches was made recently, says the *Railroad Gazette*, in Columbus, O., on the Columbus, Hocking Valley & Toledo. A coach with the battery suspended underneath was attached to a train, and a trip made to Logan and return. During the entire trip a satisfactory light was given. For a time four 20 c. p. incandescent lamps were used, illuminating all parts of the coach. Later, two 30-candle lamps were substituted. Probably the most pleasing experiment was with a single 50-candle lamp. This illuminated the car more satisfactorily than any two ordinary coal oil lamps.

A Remarkable Electric Light Plant.

Our readers will recall the curious source of power for some of the dynamos of the lighting plant connected with the Ponce de Leon Hotel, at St. Augustine, Fla. This consists of an artesian well, the water of which drives the dynamo. That installation, however, does not stand alone, being equaled, if not exceeded in its remarkable character, by the installation of the Yankton Electric Company, of Yankton, D. T. The source of power there is a flowing well 600 feet deep, and the arrangement of the plant is shown in the accompanying sketch. The water comes up through a 6-inch casing *A*, and passes into an old boiler *B*, which acts as a trap to catch the stones which are sometimes thrown up by the well. A pipe *C* leads to a 12-inch Fleniken turbine *D*, with a fall of 30 feet.

The turbine, which is controlled automatically by a Pritchard electric governor, drives the dynamos of the Weston type.

The pressure in the boiler *B* is 7 pounds under full head, and 57 pounds to the square inch when the well is closed.

The prices charged for lighting are as follows:

ARC.

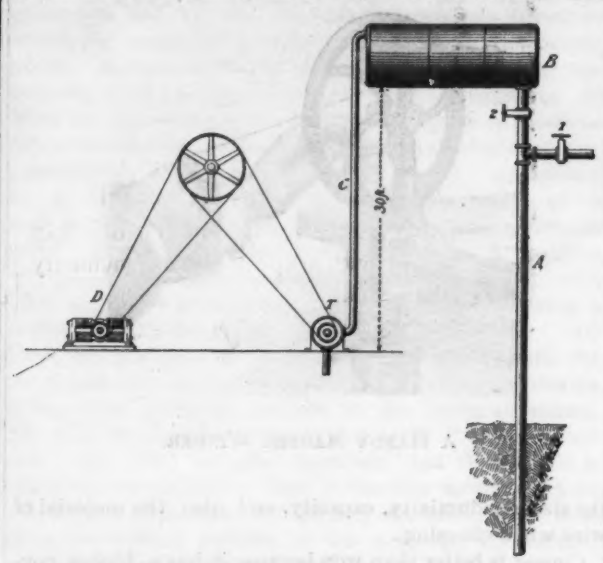
1	$15 per month	Dark till midnight.
2	28 "	
10	125 "	All night.

INCANDESCENT.

1 to 8	$1.50 each per month.
9 to 15	1.25 " "
16 or more	1.00 " "

The renewals are furnished by the subscriber on the basis 600 hours life.

The present plant of 30 h. p. being inadequate to supply the demand, a second well will be sunk at once.



DRIVING AN ELECTRIC LIGHT PLANT BY ARTESIAN WELL.

Dry Primary and Secondary Batteries.*

BY M. KOUZNETSOV.

1. GELATINO-GLYCERINE PRIMARY BATTERY.—In order to construct the containing vessel of this battery, I take cardboard, which I paste, leaf upon leaf, in such a manner as to obtain a plate 8 or 10 mm. thick. I dry this in a press, then I cut it into strips 10 mm. wide, with which I form a rectangular frame 150 by 300 mm. When the whole is quite dry I impregnate the frame with hot paraffin, and on one of the open sides of the frame I place a thin sheet of tin, which I cut according to the external boundary of the rim. I thus obtain a small box, the sides of which are formed by the cardboard and the bottom by the sheet of tin. Within this receptacle I spread sulphate of copper in small fragments up to a thickness of 2 mm. Then I cover this layer with a mass of gelatino-glycerine, prepared in the following manner: Melt on a slow fire a given quantity of gelatine until it forms a viscous liquid mass. While stirring the latter on the fire add to it four-tenths of its volume of glycerine, which is preferably mixed with the same quantity of concentrated sulphuric acid (65° Baumé). The entire mass being well mixed, I allow it to evaporate to an amount indicated by experience. I then spread it in the cell so that it rises to about a little more than one-half its height. When the mass is solidified and has become an elastic and firm jelly, I cover the surface almost to the top of the box with fragments of zinc well amalgamated, upon which I spread again a layer of the gelatino glycerine mass (it being well to heat the zinc a little). When I have thus constructed the desired number of elements, and cooled them so that the mass has taken its desired form, I proceed to mount the battery.

The first element is placed with its bottom of tin on a board, having on its upper side a plate of copper fixed by means of screws, and the size of which is a little larger than the size of the elements. On this first element I place the second, with the tin sheet at the bottom, and so on, until the desired number of elements has been reached necessary for the battery. On top of the last I place a sheet of tin, then a board, similar to that upon the bottom of the battery. These two boards are solidly united by means of four bolts, which can be screwed up tight by means of nuts. One of the bolts is connected with the copper plate at the bottom, and the other with the upper plate. They both serve as terminals for the battery. It is evident that with this mode ofgrouping, the elements are joined in series.

The constancy of this battery is remarkable. A galvanometer placed in the circuit for six days with a battery of this type maintained the needle on the same division where it rested at the beginning of the experiment. The battery is perfectly adapted for ringing bells, and for telegraphic and telephonic apparatus, of which I have convinced myself by numerous experiments. It is especially advantageous for field telegraphy, where it is necessary that the battery be enclosed in a box of small dimensions. As it weighs only 10 to 15 pounds, it can be placed in a leather knapsack and carried on the back. It leaves almost nothing to be desired in the way of simplicity of construction, ease of mounting, and life as compared with the existing battery. It requires neither replenishing nor attention, and does not require to be placed in a special compartment. The humidity and normal variation of temperature of the air have no effect on the action.

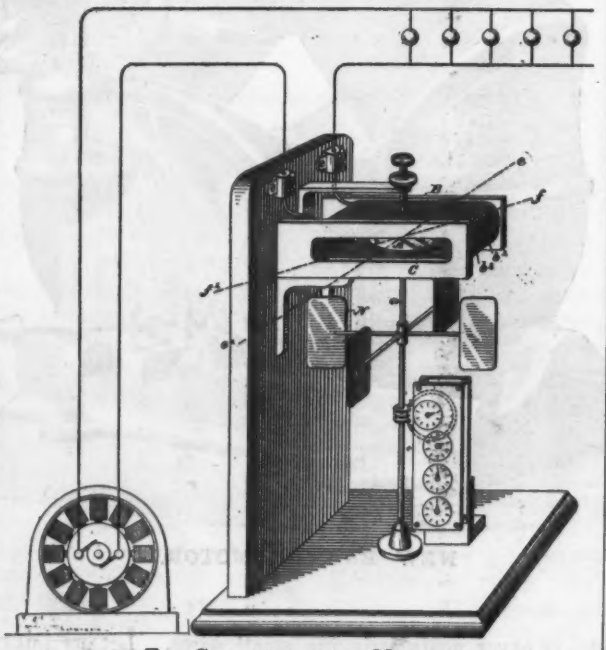
*Elektritcheatvo.—Rev. Int. d'Electricite.

Finally, the pressing together of the boards by means of bolts and the impregnation of the sides of the elements with paraffin give to the whole battery practically an hermetic seal.

2. SECONDARY BATTERY, GELATINO GLYCERINE ACCUMULATOR.—My secondary battery is based on a principle almost identical with that of the primary battery. For the construction of this cell I employ a frame similar to that which was described above, but to which I give a height of 50 mm. Then I impregnate this with paraffin, and place on the bottom a sheet of tin, or rather of lead. The gelatino-glycerine mass is made in the same manner, except that I replace the sulphuric acid by acetic acid or nitric acid, preferably the former. When I have a sufficient quantity of this mass, I divide it into three equal parts. I mix two of these parts with a definite quantity of acetate or nitrate of lead, according to the acid employed. After having made this mixture with precaution over a slow fire, I carefully fill one-third of the box with it, and allow it to cool well. Then I add a little less than one-third of the mass which does not contain the lead salt, and when this second layer is well cooled, I fill up the box with the rest of the mass, which contains the lead salt. In this manner there are contained in the box three layers, of which two, thicker than the other, are at the extremities, and one at the centre, which acts as a diaphragm. The upper part of the element is covered with another sheet of lead, and the whole system is bound together between boards, exactly as in the case of the primary battery. The boards carry copper plates provided with binding screws.

The description and mode of construction of this battery indicate the manner in which it is charged and discharged. The advantages of this accumulator are the following: 1. Remarkable lightness. 2. Absolute impossibility of rupture of, or of contact between, the active plates. 3. Large charging surface, the oxides of the latter being in a very finely divided state, or rather in solution, and surrounded by a layer of gelatine. At the end of a certain time they form a chemical combination with the glycerine and form a flexible, elastic and firm plate inclosing a sufficient quantity of humidity.

During the charge of the accumulator, phenomena are produced analagous to those noticed with the existing types. At one of the plates there is formed peroxide of lead, and at the other lead, or rather a spongy hydrogenated mass of lead. The charge and discharge does not destroy or modify the plates. It is unnecessary to form them, as is required with the elements of other secondary batteries. It is only necessary to charge them every time from another pole, i. e., to put at the anode the plate which was before the cathode.



THE SHALLENBERGER METER.

The current of this battery when charged is of remarkable strength and constancy. These qualities can nevertheless be varied, and depend on the chemical purity of the substances employed. For the preparation of the lead cells I use litharge and the red lead of commerce, the purity of which is not guaranteed, any more than that of the glycerine, which is very difficult to procure in Russia.

Shallenberger's Alternating Current Meter.

We illustrate in the accompanying engraving an ingenious form of electric meter designed by Mr. O. B. Shallenberger, electrician of the Westinghouse Electric Company, and in which electrical energy is converted into mechanical motion, the rate of which is directly proportional to the energy being consumed.

The principal elements employed in the construction of the meter are, first, an armature of metal capable of rotation; second, an electric circuit, which is so arranged that when it is traversed by alternating electric currents a field of force is induced having a given polar line or axis with reference to the armature; and, third, a circuit so related to the first circuit that currents are produced in such second circuit by the action of those in the first, the phases of which succeed those of the currents in the first circuit and set up for the armature a second field of force, the axis of which intersects that of the first. The armature may be built of soft iron, or of copper, or other non-magnetic metal, or it may be composed of a core of soft iron having a conducting circuit of other material surrounding.

Referring to the engraving, *A* represents a circular armature, mounted upon a shaft *a* and placed within a coil *B*. The coil is made in two sections b^1 b^2 for convenience of construction, the shaft *a* passing between the two.

Alternating electric currents traversing this coil tend to establish a field of force whose polar line or axis is approximately in the direction *e e'*. A second conductor *C* is placed in inductive relation to the conductor *B* and armature *A*. This conductor is shown as closed upon itself. It is placed with its magnetic axis at an inclination to that of the coil *B*. Alternating electric currents, traversing the conductor *C*, establish a field of force for the armature, whose polar line or magnetic axis is approximately in the direction *f f'*—that is to say, inclined with reference to the polar line of the coil *B*. It is found in practice that when the coil *B* is traversed by alternating electric currents the armature will revolve in the direction indicated by the arrow *x*.

In order to produce a rate of rotation of the armature proportional to the amount of energy supplied to the circuit, it is necessary that some retarding force should increase in its effect by the same law as that of the rotating effect produced by the current. If, for example, the tendency to rotation increases as the square of the current, then the retarding effect should increase as the square of the speed. Such a definite law of increase of retardation is secured by the application of fans or vanes *N* fixed to the shaft *a*. The resistance offered by the air to the rotation of these vanes affords the required retardation.

This meter is said to respond to the currents traversing the coils *B* in such a manner as to obtain a reliable and accurate measurement of the current, the number of revolutions performed in a given time being directly proportional to the current consumed during that time.

It is found, in practice, that the resistance of the coil *B* may be made very small, and the current consumed in operating the meter itself quite insignificant.

The number of ampère hours are recorded by the registering train geared to the shaft.

We understand that this type of meter will be regularly employed by the Westinghouse Company in their central station work.

An Absolute Electrometer Formula.

To the Editor of The Electrical World:

SIR: In THE ELECTRICAL WORLD of May 15, 1886, page 222, please state what *L* represents in the formula given in the article descriptive of an absolute electrometer.

The formula given is $V^2 = 4\,F.\,L\frac{R}{r}$.

ELMIRA, N. Y. B. C. W.

ANSWER.—The entire expression $L\frac{R}{r}$ represents the mean area of the cylinders *A* and *B* in the illustration, and is to be taken as given in square centimetres.—EDS. E. W.

An Electric Bell Story.—The Wayne, N. Y., *Press* says: A story in the *Geneva Courier* reminds a *Press* reporter of a Geneva girl, a member of "Main street society," who once registered at a hotel in this village. Upon being shown to her room she at once retired. Two hours later she awoke nearly frozen and discovered that the bed clothing consisted of a sheet and spread. Jumping up she turned on the gas and placing her lips in close proximity to the electric bell call, she began to yell to the chambermaid for "more quilts." Her cries attracted the attention of the police, who forced the door and found her writing a letter charging the telephone company with incompetency and neglect of duty. When told that the little button on the wall was not a telephone she immediately went into hysterics, since which time she has never been recognized by her "set."

SUPPLEMENT TO
THE
ELECTRICAL WORLD

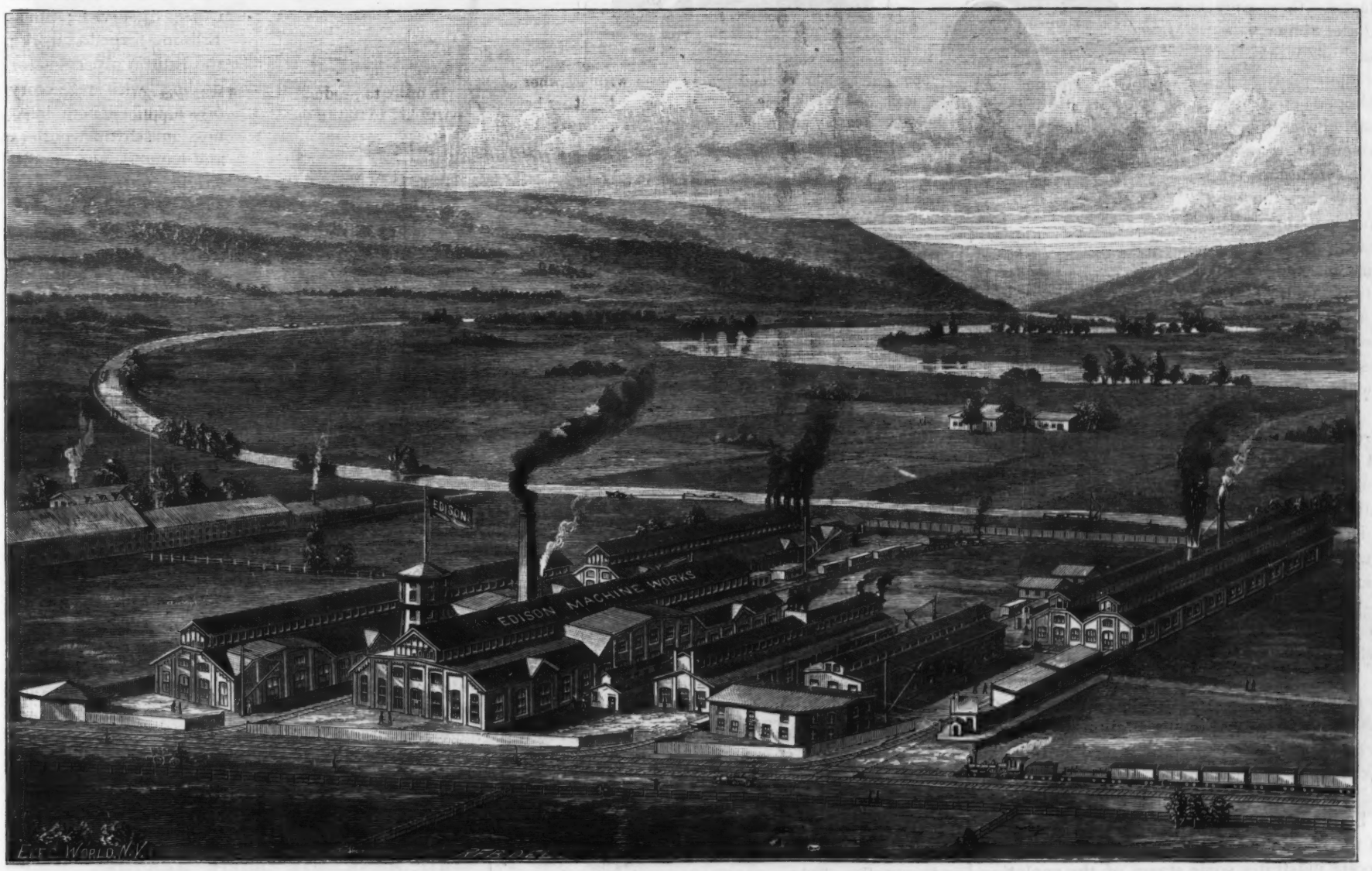
VOL. XII. NEW YORK, AUGUST 25, 1888. No. 8.

A DAY WITH EDISON AT SCHENECTADY.

PASSING swiftly through the suburbs of the sedate old city of Schenectady, on the New York Central Railroad, and glancing carelessly out of the car window, to note, perhaps, the famous scenes of Dutch and Indian warfare of two centuries ago, one's attention is arrested by a huge range of factory buildings and by the numerous signs of pressing activity in and around them. Massive and handsome, lifting themselves boldly up from the level meadows of the Mohawk Valley, their appearance, as one after another of the roofs swings into the line of vision, arouses curiosity, for it is easily to be seen that the place is the home of an industrial enterprise of no mean order. The contrast with the surrounding pastoral scenery does but accentuate all the evidences presented of busy toil. Beyond the factory, as it lies solidly athwart the view, with its long facade to the railroad and its remote rear bordered by the Erie Canal, winds and doubles the placid Mohawk River, hemmed in by green banks and girdled by uprolling mountains well away to the northward. There, in the legendary background, the atmosphere hangs drowsily, as well it might, over the quaint homesteads built by the ancestors and offspring of sundry Rip Van Winkles; but here the air is astir with the sharp outburst of steam and smoke and athrob with the pulsation of machinery. There, along the circuitous highways, the heavy wagons, with heavier teams, are hauling slowly to market the growth of farm and make of dairy; but here in the forefront, and fixing the eye as insistent energy and bustle always do, especially when on the grand scale, are trains of freight cars alive with men unloading raw material at the factory yard, while others at half a dozen different points are carrying away the finished product of the works.

The spot that has thus won our notice, merits it. We are looking at one of the greatest exemplifications of the power of American inventive genius, and at an establishment where, from beginning to end, a new art is illustrated by new processes. One would hardly seek for the latest developments of scientific discovery and engineering skill in this peaceful rural region; but they are here, and amid people and scenes that even in Europe would wear an ancient air, we can watch the manufacture of the novel appliances of modern electricity. It is, indeed, not a little singular that the quiet city of Schenectady, seated by the still waters of the Mohawk, a home of peaceful learning, and the centre of a rich dairy district, should have become closely identified with the most striking advances in American commerce and manufacture. Not only were its fortunes at one time fostered by the opening of the Erie Canal, whose importance even at the present time is so great, but it built some of the earliest locomotives, and nearly sixty years ago it was running passenger trains to and from Albany. To-day it has as its most prominent and prosperous industry the manufacture of dynamo-electric machines, electric motors and kindred apparatus in an establishment over which floats the name of Edison.

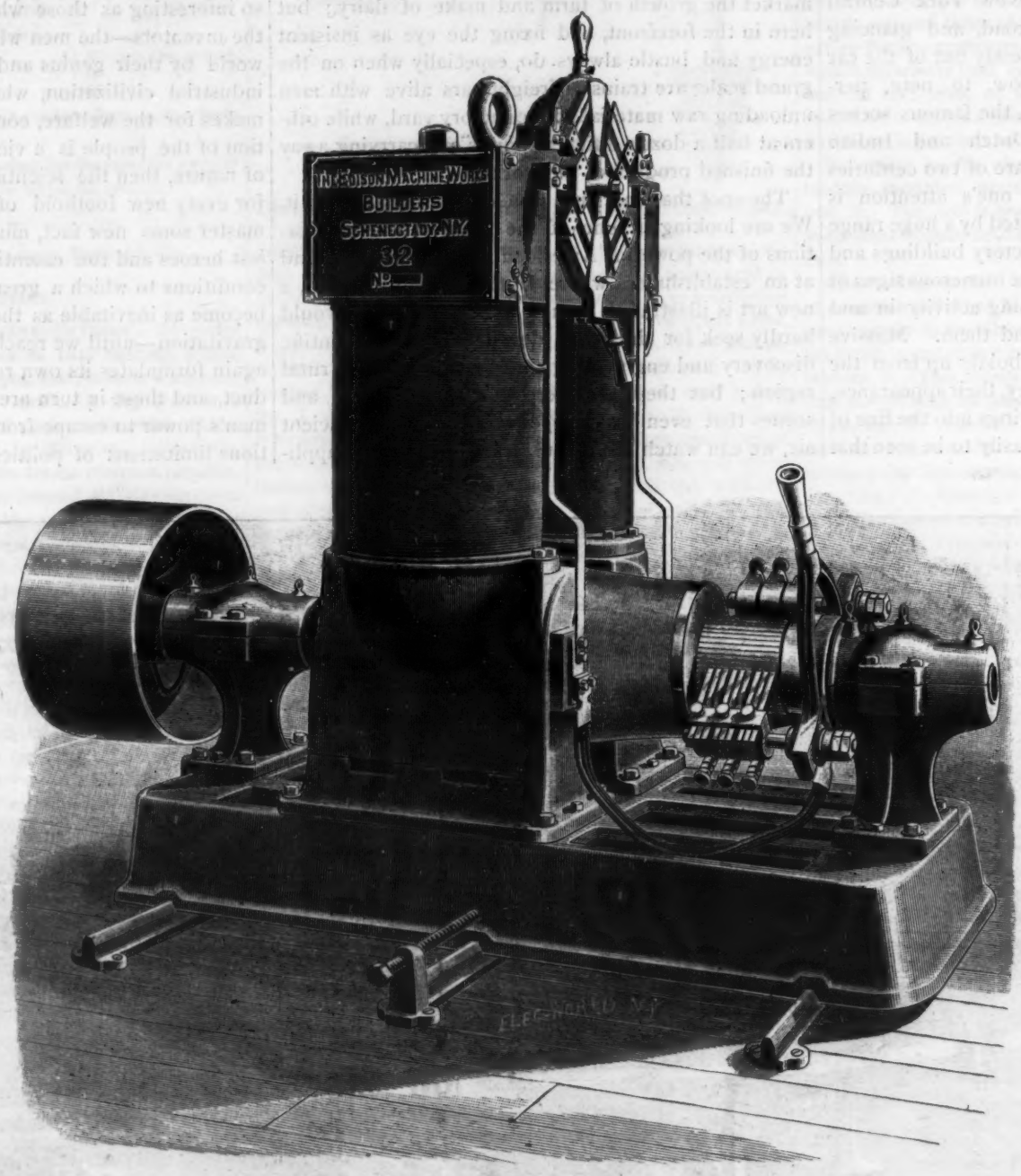
There are few chapters in American national life so interesting as those which concern the careers of the inventors—the men who have revolutionized the world by their genius and their skill. If ours be an industrial civilization, wherein each discovery that makes for the welfare, comfort and broader information of the people is a victory over the brute forces of nature, then the scientists and inventors fighting for every new foothold of truth and struggling to master some new fact, must be accounted the worthiest heroes and the essential rulers. The unfamiliar conditions to which a great invention introduces us become as inevitable as the laws of magnetism and gravitation—until we reach a further invention which again formulates its own rules for our life and conduct, and these in turn are invincible. It is in every man's power to escape from or to modify the fictitious limitations of politics or diplomacy; but while the statesman is astounded to see a mere "geographical expression" transformed into a vigorous nation, and while the soldier learns that Providence has deserted the biggest battalions for the biggest guns, the inventor from whose brain spring the steam engine, the electro-magnet, the sewing machine, photography, the electric light, the type-writer, dynamite, the pistol, the phonograph and the rock-drill, knows that it is he after all who is doing these things and dictating for his fellows, but like a wise despot, the new terms by which their happiness and their very



THE EDISON MACHINE WORKS, SCHENECTADY, N. Y.

existence are bounded. It is the perception of this governing principle in modern affairs that gives such interest to the achievements of invention, and causes us all to await with such anxiety the moments when the toy or the failure of the laboratory on a sudden becomes the dominant factor in society, diverting the vital currents into new channels of activity and enlisting the intellectual enthusiasms of the age.

No one, we believe, will deny to Mr. Edison his well-earned position among these men who shape the times; and it certainly cannot be gainsaid that in the popular mind and estimation his name has been peculiarly and distinctively associated with the great electrical arts and applications that belong to the last twenty-five years. It was not, however, his earlier work that realized his largest ambitions in the electrical field, for what he was then aiming at was economy in the older departments rather than the exploitation of the new. But "the young man that kept the path to the Patent Office hot with his footsteps" was in touch with all the wider conceptions of the possibilities of electricity, and took out patent after patent as the pre-emption of provinces where all as yet was virgin soil. It is a pleasant reminiscence of one of his nearest friends that just at the time of the demonstration of the commercial feasibility and practicability of the incandescent light, Mr. Edison remarked to him one day as they were passing the Singer Sewing Machine Works, at Elizabethport, N. J., that he hoped before long to be able himself to give employment to as many men as were there engaged. Within the decade the laudable wish has been gratified, for if reckoning be made of all the various factories in America, Europe and Asia, where Edison inventions are manufactured, it will be found that a total of several thousand artisans is easily reached. Of these establishments, one of the most extensive and noteworthy is that to which we have above alluded, and which is the subject of the present Supplement to THE ELECTRICAL WORLD, the Edison Machine Works at Schenectady.



THE EDISON DYNAMO ELECTRIC MACHINE.

If the readers will take the trouble to run through the pages of Dr. Benson Lossing's admirable *History of American Industries and Arts*, issued at the time of the Centennial Exposition, he will discover that complete as the work is it makes no mention of dynamo building. The fact is significant as to the youth of the new industry and as to its growth. The case in point illustrates some stages of the evolution. The Edison Machine Works represent the amalgamation of three businesses, all based on the dynamo. One was the old Edison Machine Works at Goerck street, New York, founded and owned by Mr Edison, and started in March, 1881. The second was the Electric Tube Company, of which Mr. John Kruesi was manager, with factories first in New York and then in Brooklyn; and the third was the Edison Shafting Company, which was carried on as a department of Goerck street. The company representing these combined interests removed to Schenectady in December, 1886, prosecuting its work with such vigor that inside of the first year the plants and tools were reinstalled, the shops were reorganized, and treble the business was done.

The location of the Works has already been described. The view shown in our engraving is taken from a hill to the south, not far from Union College. The property is triangular in shape and covers thirteen acres, of which about five acres are under cover, there being, all told, twenty-six separate buildings in use. The chief boundaries are the New York Central Railroad, the Delaware & Hudson Canal Company Railroad, with both of which there are siding connections, and the Erie Canal, on which the Works have a fine dock frontage. It will be seen, therefore, that the situation is eminently favorable for the handling of freight, and the advantages have been enhanced by the laying of rails all through the yards and shops. There is a total of nearly two miles of track, and the finished product can be loaded into the cars at five different shipping points.

As regards prime power, the Works are well equipped. There are two Brown engines of 100 h. p. each, one of which, it is interesting to note, by the way, was brought from Mr. Edison's well-known old laboratory and workshops at Menlo Park. These are in the principal machine shops. There is also a Straight Line engine of 100 h. p., which operates the foundry and supplies light, running twenty-two hours a day. Another Straight Line engine of 50 h. p. is in use in the dynamo testing department, and the shops Nos. 3 and 6 are driven by large Edison dynamos employed as motors. Steam is furnished by two extensive boiler rooms, the main one being attached to shop No. 1, while the other adjoins the foundry. The piping is so arranged as to take steam from any boiler to any engine. The boilers not only feed the engines but warm the buildings in winter, overhead heating being successfully employed. The exhaust is used, supplemented whenever necessary by live steam. Light is given by about 900 Edison lamps scattered throughout the factory, while gas is put to its appropriate duty by being used as fuel. The Works make their own fuel gas, and it is in great demand for heating and manufacturing purposes. The supply of coal is conveniently and cheaply maintained. Water is drawn from a series of no fewer than twenty driven wells all over the works, and a partial supply comes also from the city water-works. Provision against fire is made with the large tank, seen in front, having a capacity of 20,000 gallons.

The Works employ from 750 to 850 hands, according to the season of the year, and at the time of the writer's visit, about 775 were on the rolls. Work is chiefly done on the contract basis. There are occupied on the business of the Works, outside, from 50 to 100 employés. Large as this force may seem, there is every promise of an increase, and the Works are now in course of extension. Although the products of the Works are in a sense restricted, as no lamps or fixtures are made here, the business has several very distinct departments, any one of which would suffice to tax the highest executive ability. These departments include the building of Edison dynamos; the construction of Sprague electric motors for stationary and street railway work; the manufacture of Edison electric tubes for underground work; every branch of the insulated wire business for all classes of service; Sims-Edison torpedo work; the Edison processes for dealing with refractory ores; and a general business in shafting, pulleys and hangers, and in millwright and foundry work. It is always gratifying to see a self-centred and self-contained establishment such as is here found. The company purchase only pig-iron, bare copper wire, copper ingot and rough forgings, and these passing through the various stages and complemented by the different parts that go to form the whole, come out in shapes of beauty and utility.

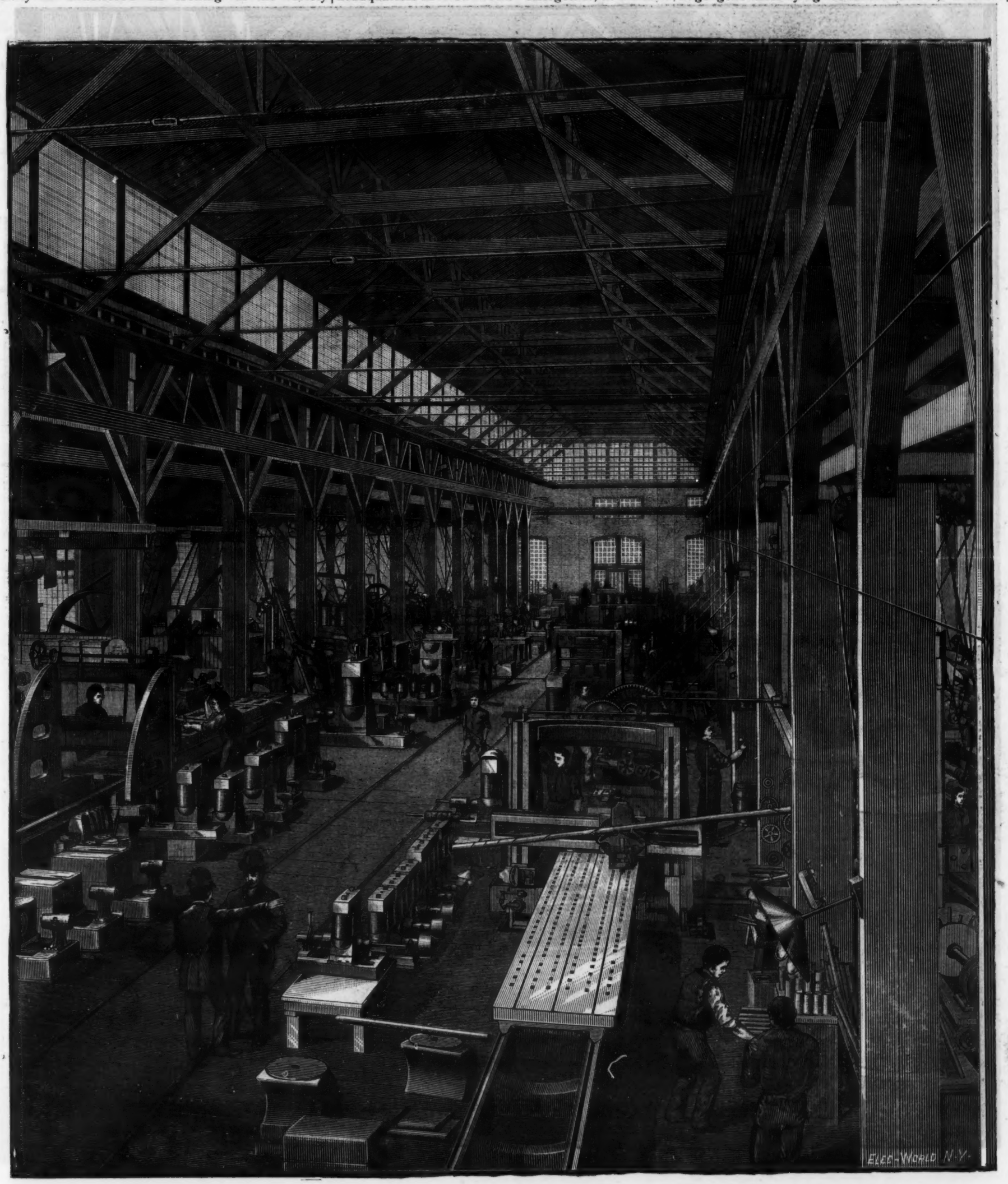
On pages 3 and 4 we have views of the northern and southern halves of the noble machine shop, No. 2. This structure is not less than 122 feet wide and and 306 feet long, and deservedly claims our attention first. Its central aisle is 40 feet wide, and there is a cathedral-like airiness and distance in its long perspectives. Five hundred men can easily find elbow room here for their work, with all the machinery. How pregnant with results, and how impressive simple ideas become, when they are seen commanding the labor of an army of men and exacting service from miles of machines whose roar is that of the sea! All this cyclopean activity around us goes back for its cause and its explanation to a bit of wire coiled about an iron bar and a tiny filament in a fragile glass globe, creations so elemental that they might well be supposed to belong to the primeval heaven-taught arts, did we not know that their utilization has but begun, and that they are among the greatest gifts of modern philosophy and invention. In such a place as this, the prosaic and the marvelous jostle each other. Here are 6,000 feet of shafting and some 50,000 feet of belting, driving nearly 400 separate mechanisms, in the production of apparatus

whose birth was yesterday. Right and left are gigantic machine tools of every kind and style; here a planer 60 by 60 inches and 32 feet long; there a special boring mill, built to order at a cost of $6,000. The value of the tools, in fact, runs up into hundreds of thousands of dollars, and their multiplicity is understood on looking at the variety

ing directly to the engine, and those for the United States cruiser "Yorktown" were seen in course of construction. Others, of quite another type, are those generating current for telegraph circuits, as illustrated recently in THE ELECTRICAL WORLD in a description of the Postal Telegraph Company's new plant at headquarters in New York. Altogether, at the time

pushed through for the new Edison central station at Philadelphia. The machines to be used in the New York stations are shown on page 2. They are known as No. 32's; the weight is 16,200 pounds and the output is 575 ampères at 140 volts.

The aspect of the floor in this vast shop, with the huge generators lying amid the motors, like stately



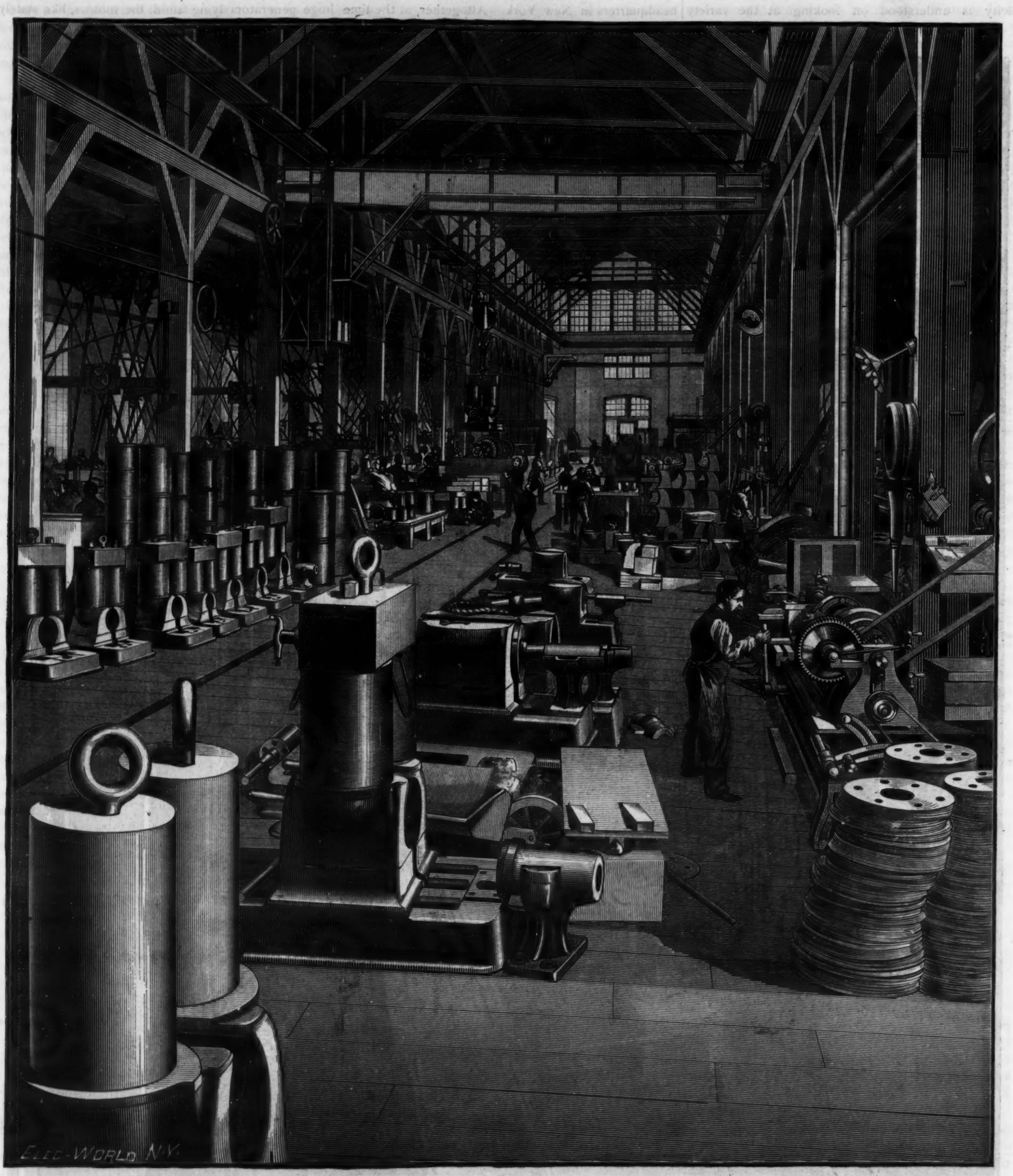
CENTRAL AISLE, NORTHERN HALF OF NO. 2 MACHINE SHOP, EDISON MACHINE WORKS, SCHENECTADY, N. Y.

and extent of the work in hand. At one end of the shop immense pulleys and lines of shafting are passing through the necessary Processes, and a quantity of gearing for electric street cars is being cut. As a rule there are from 200 to 250 dynamos in course of assembling in the central aisle. The Works not only build dynamos of the standard Edison type, but often are called upon to meet special wants. Such are ship lighters, run at slow speed and connect-

of the writer's visit, 262 dynamos were under way, varying in capacity from 5 ampères to 1,000; about 200 stationary motors, from ½ to 20 h. p., and more than that number of street car motors of 7½ h. p. each. The largest Edison dynamo then building was a giant of 1,000 ampères and 140 volts, known as No. 56. Its weight, roughly, is 27,500 pounds. The heaviest piece of metal in it is the keeper, weighing 6,400 pounds. Eight of these machines were being

lionesses surrounded by their whelps, is very suggestive of the new order of things. "Numerous attempts have been made," says Herbert Spencer in his treatise on education, "to construct electro-magnetic engines, in the hope of superseding steam, but had those who supplied the money understood the general law of the correlation and the equivalence of forces, they might have had better balances at their bankers." And yet, here we are, looking at literal

hundreds of these very electro-magnetic engines, some of them intended to take the place and do the work of steam locomotives, while the remainder go to join thousands more already at work in nearly 150 industries in which they have been given the preference over steam engines and every other kind of motor. There is after all some truth in the remark, even when applied to philosophers, that "the world requires half a dozen years to learn of any advance and half a dozen more to understand it," for the fact of the supremacy of the electric motor lies in its ability to do work where the steam engine is not admissible and to serve as the neat and cleanly retail agent in distributing the energy of steam produced cheaply at wholesale in some central electric station where all its objectionable features are hidden from sight. The work being done in one of the aisles of this shop exemplifies, remarkably too, the ease with which the electric motor can be adapted to difficult tasks—namely, its use in the Sims-Edison electric torpedo, the construction of which is being actively carried on to fill contracts for the American and foreign governments. This torpedo is the only one driven by power external to itself. It is a submarine boat with a cylindrical hull of copper and conical ends, fastened by steel stanchions to an indestructible float, which carries two hinged rods for showing signals just above the water. It weighs about 3,000 or 4,000 pounds. In one section of the torpedo is an electric motor receiving current from the shore by a light cable which is paid out as the torpedo proceeds. Hence the action of the motor driving the screw propeller is under complete control of the firing officer on shore or shipboard, who can manœuvre the craft at will, start or stop, avoid obstacles and fire the charge at the right moment. Some extraordinarily successful results have been obtained with these craft, the only ones of the kind, and it will be observed that the apparatus is unsurpassed for

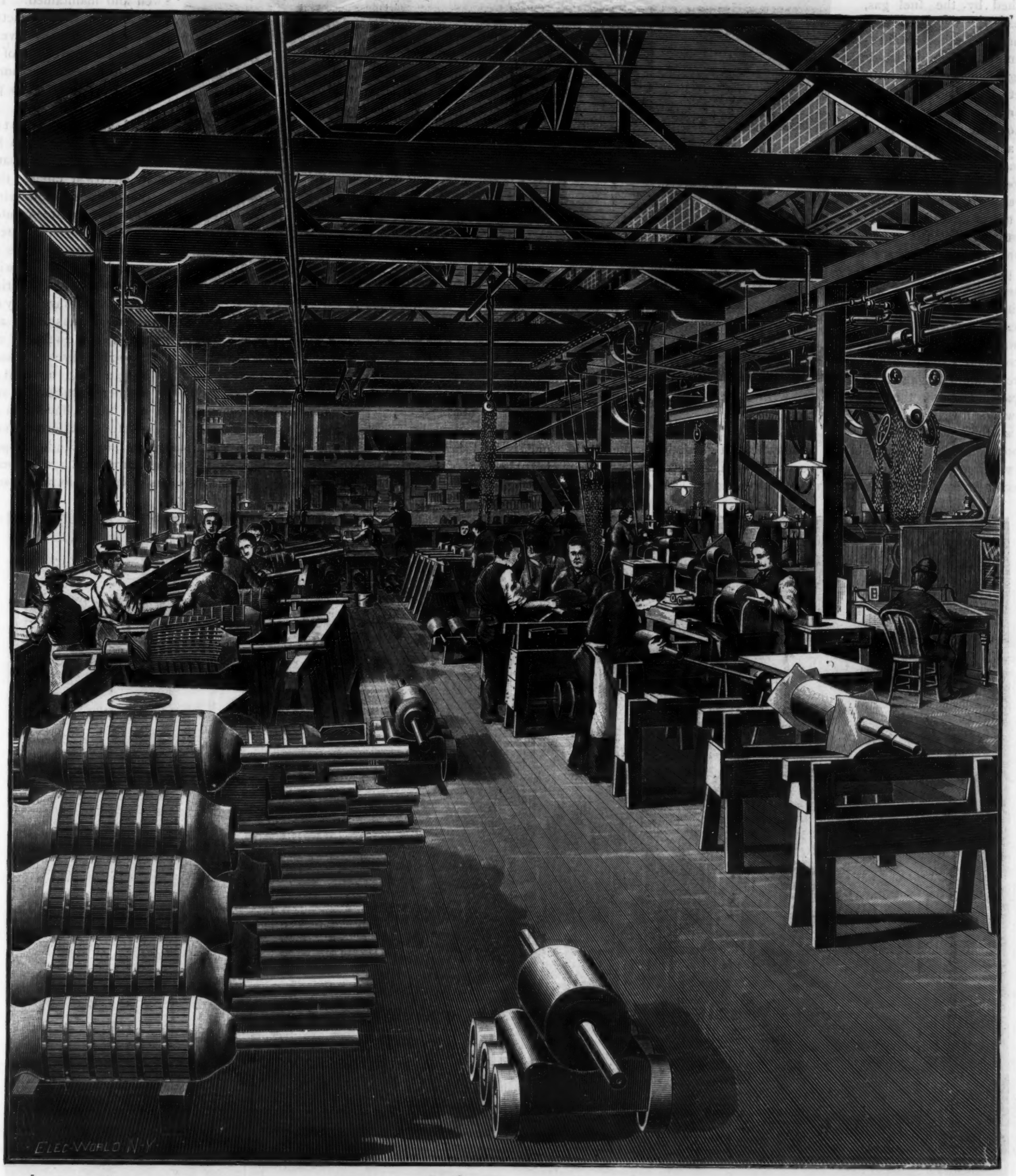


CENTRAL AISLE, SOUTHERN HALF OF NO. 2 MACHINE SHOP, EDISON MACHINE WORKS, SCHENECTADY, N. Y. SHOWING THE AREA FOR ASSEMBLAGE OF DYNAMOS.

handiness in having an unlimited supply of power for propelling it, and in being governable at every minute of its trip out or home again. The cylindrical shape of the torpedo and the limitations of weight have necessitated the construction of a motor of special design, with field magnets completely encircling the armature. Speaking of this torpedo, after some of its first experiments, General McClellan, in an official letter, described it as "the best of the movable torpedoes yet invented". It is some satisfaction to know that when the Haytian navy invades our coasts, and France seizes the Isthmus, we shall, though without a fleet, still have a defensive line of Sims torpedoes within which to assert the authority of the Monroe doctrine and our determination to enforce it, against all comers.

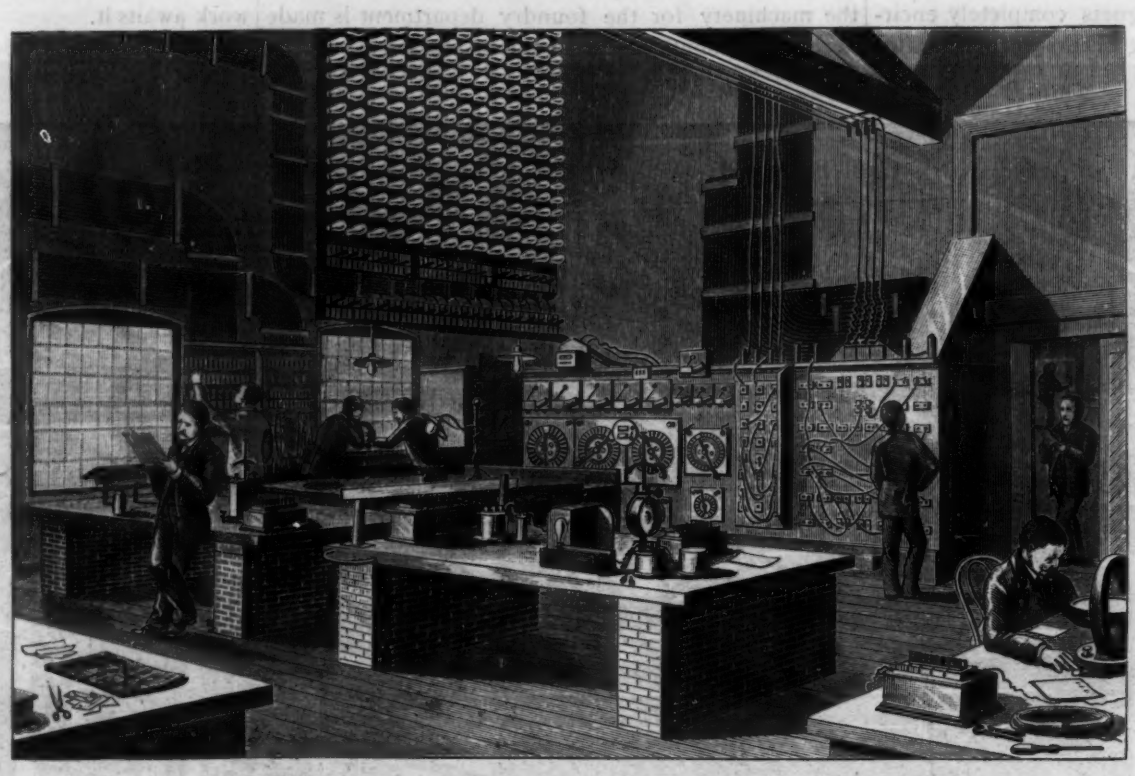
One might linger in this shop a week, so endless are the points of interest that it presents. A casual question as to some strange tool elicits the information that the company construct all their own tools here, except those ordinarily to be had in the market. All the machinery for the foundry department is made here, and a month or two ago upon the receipt of an order for 25,000 feet of a specially insulated cable, the machinery was at once designed and built on the spot. Resources of this nature give an establishment courage and daring for the most onerous enterprises. It should be added that in this shop also the commutators for the dynamos and motors are made—mica being used between the bars—and the general work of assembling is done. By means of the overhead power traveler, handling ten tons, the big machine, whose bed-plate, fields, pole pieces, keeper and bearings were widely scattered a few hours since, is hoisted into line as a solid entity, and if need be, before the night whistle blows, it will be fitted with its armature and be far on its way to the place where work awaits it.

By natural transition our thoughts now wander from the heavy work connected with dynamo construction to the finer and more delicate manipulation required in the production of an armature, and we find our way to shop No. 1, where the extensive department of armature winding is situated. The view given on this page shows only about a quarter of the shop. The Edison armatures, which are, as is well known, of the drum form, are built up of thin discs of iron, insulated from each other by



PORTION OF THE ARMATURE WINDING DEPARTMENT, EDISON MACHINE WORKS, SCHENECTADY, N. Y

tissue paper, and a glance at the illustration will show how minutely the whole work is subdivided—building up the cores, fitting them on the armature shaft, boxing the ends, winding, strapping and soldering the connections between the sectional coils and commutator bars. The heat for soldering is furnished by the fuel gas, while the overhead railroad and other arrangements facilitate the handling of every piece. In fact, it is only the lazy man who does any hard labor here; the busy man, in a hurry, at once avails himself of the conveniences provided for speedy work. It is an evidence of the progress in this department that the repair work brought in is barely 25 per cent. of what it was when the company was doing but a quarter of its present business. At first it was the practice to keep a complete gang of armature winders engaged on repair work, but there is now so little of it that it is done at odd times. Another interesting detail is the employment of girls in winding, on such sizes as they can deal with, and special devices are now being prepared for handling the heavier pieces, so that they will be able to wind armatures for the largest machines.



SWITCHBOARD AND INSTRUMENTS, TESTING DEPARTMENT.

The testing department, illustrated on this page, is in the same building. Each machine, as soon as ready, has its connections brought to the switch-board, and it is then tested for load for several hours. A Straight Line engine of 50 horse-power is used in this department, but by causing the dynamos to operate motors driving back again on the shafting, about 200 horse-power is, in a sense, available, and thus several machines can practically be put through their paces at the same time, as shown below. The connections are made to the right of the switch-board, while the readings are taken from ammeters at the top on the left, the resistance boxes being grouped below. Simple automatic cut-outs ranged above the ammeters provide for breaking the circuits in case of overload. The bank of lamps, of 40,000 watt capacity, and including lamps of 60 volts and upwards, is only used in special cases. The test room is well provided with Thomson galvanometers, Elliott bridges, standard cells, etc., but it will be understood that virtually only the commercial tests are made at Schenectady. All the scientific work of this kind is carried on at Mr. Edison's magnificent laboratory at Orange, while the results here are simply those necessary to show that the standard is reached and maintained. The dynamos now manufactured by the company have an electrical conversion of 95 per cent. and a commercial efficiency of 90 per cent.

DYNAMO AND MOTOR TESTING DEPARTMENT.

It may be doubted whether any question has been more fiercely debated in electrical circles than that of underground wires. For years past inventors innumerable have patented countless systems by means of which the wires can be successfully buried; newspapers have daily devoted columns to the agitation of the subject; city councils have discussed, rejected and adopted all manner of ordinances; subway boards have been appointed to perform the effodient ceremony, and many local electric light companies have been strenuous in their protest against being burdened with the expenses of costly failures, for such they considered every experiment to be. In all this welter of confused arguments and contradictory actions, it is a relief to alight upon firm ground somewhere, and to note at least one concrete example of success in dealing with so difficult and intricate a problem. Mr. Edison made up his mind at the outset of his work in electric lighting that the con-

ductors ought to be placed underground, and, having reached that conclusion, he proceeded with characteristic doggedness and ingenuity to elaborate the methods. He adopted iron pipe as the external mechanical protection of his conductors, his object being to provide something analogous to the means of distribution employed by gas and water companies, something which could withstand the strain of street traffic, the disintegrating influences of soil and climate, and the sudden onslaught of unfriendly pick or shovel. Inside this pipe he placed the conductors, carefully wrapped and insulated by an extremely viscous, almost solid compound, filling all interstices. Thus equipped, Mr. Edison laid some of his first "electric tubes" in New York in 1881, on the old two-wire system, and the service of those tubes has been steadily maintained, from the Pearl Street Station, to meet the demands of upwards of 600 customers ever since September, 1882. Shortly after that a second plant was put down in Milan, Italy, and a third at Santiago, Chili, both of which continue in regular and successful operation. In due time the same method was adopted for the three-wire system, and one of the most interesting portions of the Edison exhibit at the Philadelphia International Electrical Exhibition was the display showing how extensive and complete was the work even then, there being no fewer than 21 sizes of electric tubes for the three-wire system, with inclosing iron pipes of 5 different sizes, and requiring 10 patterns of junction and coupling boxes, 8 patterns of ball clamps, and 43 patterns for joints. To this number of parts the steady growth of the business has added, and every emergency and condition has been met. There are at this moment about 250 miles of Edison electric tubes underground and in operation.

A good view of a portion of the tube department, shop No. 4, is given in our illustration on this page, and from it an idea may be formed of the various stages and operations requisite to the production of a finished section of tube. The exterior mechanical

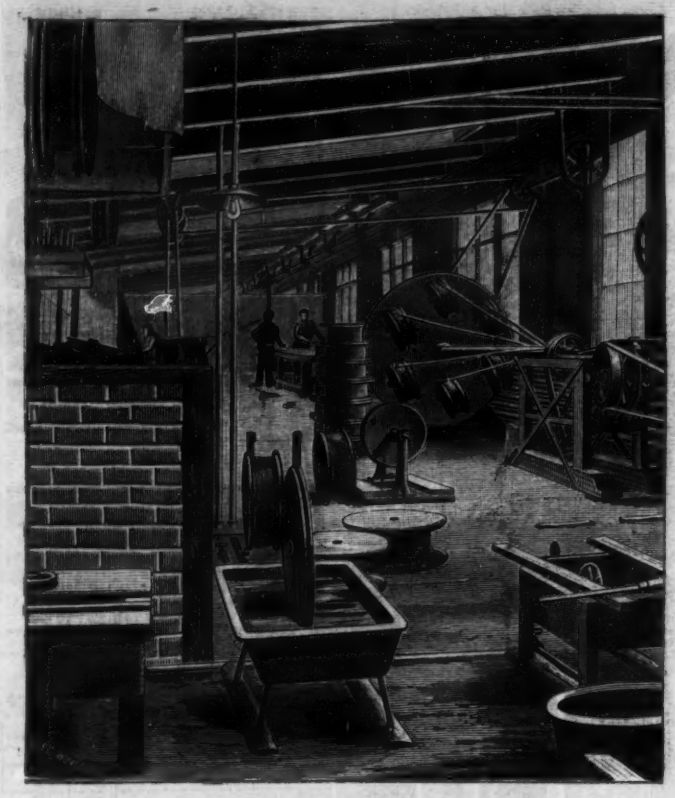
MAKING UNDERGROUND CONDUCTORS IN THE ELECTRIC TUBE DEPARTMENT.

protection is iron, as already stated, and standard sizes of iron pipe are used. Each of the copper rods receives a winding of manilla rope, run spirally. The winding is very ingeniously done, as shown by the artist. The rod is placed in two chucks, and as it revolves it is served with the rope by the little carriage traveling its length, until the end of the rod is reached, when the cordage is cut and the winding is securely tied with tape. Three of the rods thus wound individually are then put together for the

feeders, the neutral wire being of course considerably the smaller, and the bundle is given an outer winding of the same stout rope, inclosing the three pressure wires, making four jackets for the three conductors. The whole then slides smoothly and snugly into the pipe, and the semi-fluid, bituminous insulating compound is forced in under pressure. The rope itself has been well impregnated with the insulating material, and the result is a tube of the highest conductivity and insulation resistance. In the case of the mains the same practice is followed, except that while the feeders undergo no fewer than 11 distinct tests, the mains are thoroughly dealt with in 7. For these tests the current of a 500 volt dynamo is used. Rubber plugs are inserted in the ends of each tube, and the projecting portions of the rods are tinned for convenience in soldering. The pipe is used in exactly 20-foot lengths, but the cores are 4 inches longer, to allow the connections to be made. These connections take the form of copper cable or stranded wire, on the ends of which are cast composition sockets, into which fit the rods for which they are intended, and to which they are soldered. The tubes when laid are about 18 inches below the surface of the street, and there is simply filled in a layer of dirt over them before the paving is replaced. The union between the successive lengths of mains is effected in coupling boxes, fitted with ball clamps, and these mains in turn ramify from the big circular junction boxes to which the feeders run from the dynamos, and the outer covers of which are a familiar sight on the surface of the streets in New York and other cities. All these detailed devices are mentioned for the reason that they are without exception manufactured at the Works, and go to complement the product of the tube shop. A practical demonstration was afforded the writer of the flexibility of the system in the work, going on at the time, of placing all the wires at the Schenectady establishment underground and out of the way.

At the rear of the roping tables is a witches' kitchen, full of fuming cauldrons, in which the insulating compound is prepared. The boilers, as well as the other portions of the shop requiring heat in the work, are provided with fuel gas. All the arrangements are here that may be required for expeditious work, for it often happens that large quantities of tube are wanted in a hurry. Last summer, for example, 80,000 pounds of copper rod per week were used, and worked up into from 12 to 15 miles of finished tube. Mr. Kruesi, the assistant general manager, has, in fact, done much here, not only to perfect the tube system, but to increase and simplify the facilities for manufacture. As in all the other departmeats, overhead and surface railroads provide for quick handling of the work. From first to last, the shop gives abundant evidence of a firm conviction that, so far as incandescent lighting is concerned, the difficulties of underground conduction of the current have been met and conquered, and that while the fact has already been put to the proof in New York, Boston, Detroit and Chicago, Philadelphia and other cities, it is destined to an even greater recognition and appreciation. Moreover, the system exemplified has been tried and not found wanting, it is claimed, in other classes of work, especially telephony, one of the plants supplied being in use in connection with the Twenty-first Street Telephone Exchange in New York City.

The next branch of the business to be visited is the wire-insulating department, illustrated on page 9, located in shop No. 1. It affords a striking contrast with the scene just quitted, for while the conductors there became so large that they looked like sections of shafting, here they tend to the other extreme, at last being as fine as human hair; and all the machinery is naturally in keeping. This department was originally established to provide the dynamo and motor shops with insulated wire for the field magnets and armatures, but its usefulness and economy were so signally proved, that it was developed and extended, until now the Works make insulated wire of all kinds, not only for themselves, but for outside customers of all classes. The wire covered runs from the largest sizes for heavy currents down to .0015, a conductor so small that it makes 32 miles to the pound; and the insulation work includes not only cotton and silk, but rubber. The work is carried on under the direction of Mr. W. A. Phillips, formerly of the celebrated Lea works, near London, and many of the machines in the shop are of his special invention. While Mr. Phillips may be accepted as living evidence of the fact that Americans do not monopolize the ability to invent, it might perhaps also be argued by protectionists that his work exemplifies the stimulating effect of a high tariff. In other words, it was found that if American product in insulated wires and cables was to compete in price with that from abroad, made by cheap labor, it was necessary to devise mechanism that should not only be saving of labor, but should be most intelligently responsive to the skillful touch. The result is that some of the machinery is a marvel in its comprehensive ability, for it does everything, apparently, except label the completed wire. In one of the machines the bare stranded wire goes through seven distinct operations, and is delivered ready for use, with the exception, in some instances, of receiving a final coat of compound, which is necessarily applied in another place devoted to the less cleanly processes of that nature. Some of the machines run at high rates of speed. In one the spindle makes seven thousand revolutions a minute, and keeps it up with the utmost ease and indifference. The braiders seen are those of the New England Butt Company, but all the other machinery has been invented and built at the Works. Upstairs, in the galleries, as well as down-stairs, on the main floor, extreme activity prevails, and the bobbins in the braiders keep up their fascinating "set to partners" and "ladies' chain" the whole day long at a rate that makes one wonder and wonder as to where all the wire they are covering can possibly go. The department is, however, steadily behind its orders, especially on flexible cord, for which the rapid introduction of the incandescent light in residences and offices has created an insatiable demand. As showing the manner in which new applications give extension to old processes, it may be mentioned that even the trolley wires for cars on electric roads with overhead conductors have become a specialty, the Sprague Company having contracts ahead for over 200 cars requiring these trolley connections, which are unusually strong and weatherproof. Adjoining the insulating department is the place illustrated on this page, where work is done which requires heat and might interfere with that carried on inside. At the back is seen one of the large stranding machines and in front are the compound pans. Steam is used here exclusively for heating, on account of its great convenience for the purpose.



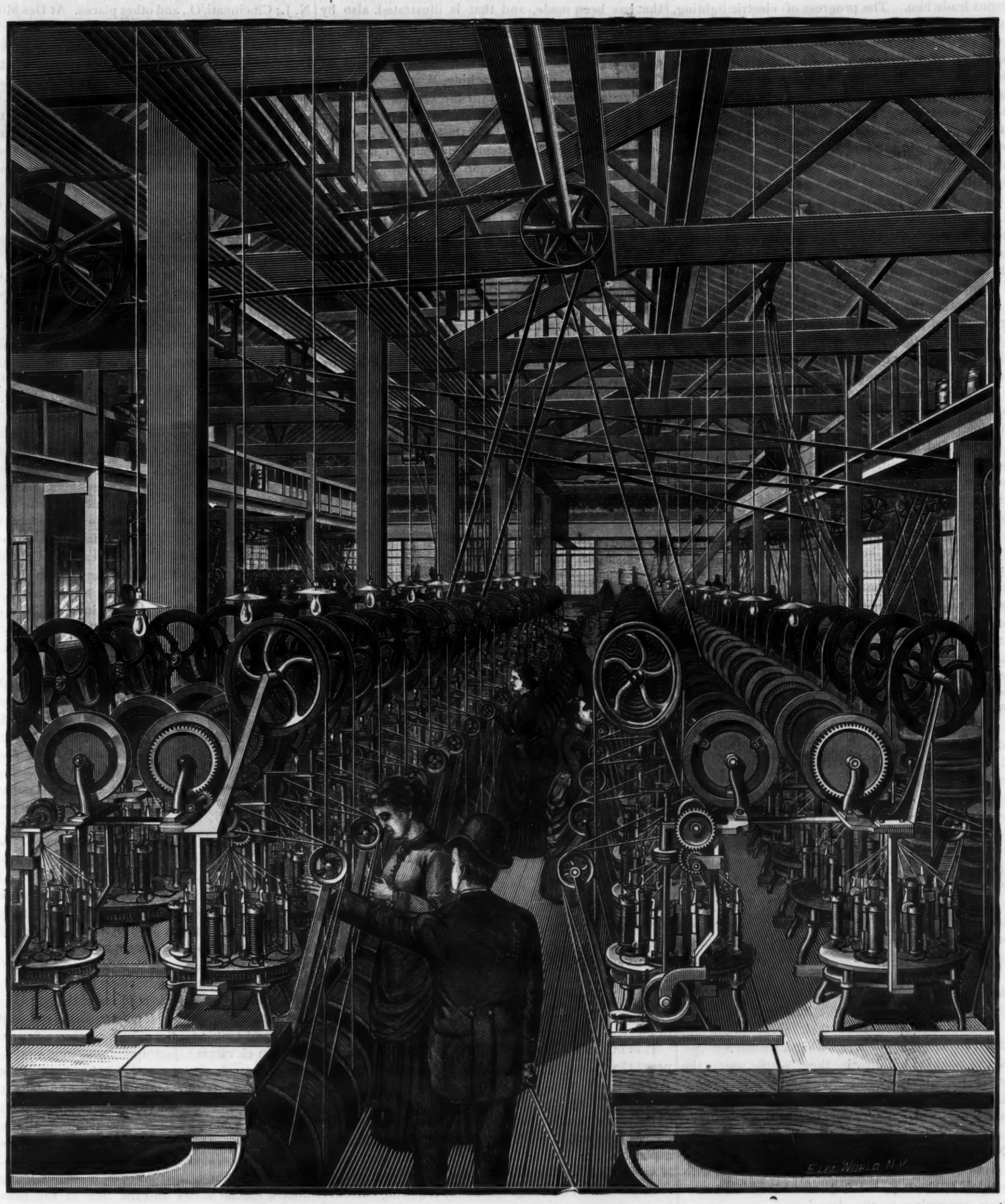
STRANDING DEPARTMENT FOR LARGE CABLES.

A CORNER OF THE PATTERN SHOP.

Arrived at this point, we may well yield to the sentiment of admiration that comes over us at the manner in which, throughout, the innumerable details have been perfected in the manufacture of the dynamos, the motors, the tubes and the insulated wires. There is stimulus in such a survey of achievement. "I am benefited by every observation of a victory of man over nature," said Emerson, and it is impossible to contemplate a vigorous young industry like this, built up out of experiment and invention in a few years, without feeling hopeful of all that still lies before. The shaping of the "infinitesimals into cosmical forces" is slow work, and the fructification of even a few of the facts that have been won by science in the electrical field has been late and tardy; but when within a decade we see electricity assuming its place as a great agency for the supply of light and motive power, founding vast enterprises, and creating a new and noble engineering profession, we may take courage and be sanguine. We need go no further than the present instance for in-

struction as to the possibilities of any electrical application. Since the first Edison dynamo was built—that for the unfortunate "Jeannette," and now lying with her in the cold depths of arctic ocean—140 central stations and 1,500 isolated plants, with a capacity of 1,250,000 lamps, have been installed in America alone to supply the Edison incandescent light, and the growth is going on at an accelerating pace. These figures are in themselves almost a fair justification of the imaginings in which the newspapers luxuriated when the electric light was in its infancy; and they certainly support beyond a cavil the remark made by Mr. Edison in an article published nearly four years ago on the "Commercial Evolution of Electricity," and which excited great criticism at the time. "Two years' experience," he said, "proves beyond a doubt that the electric light for household purposes can be produced and sold in competition with gas." They who scoffed have remained to pray, the gas companies that were so hostile and incredulous being themselves now among the most active vendors of the new illuminant, or else so anxious as to the future that their yearnings for improved gas apparatus that can struggle with it are never adequately fulfilled. Moreover, the effect of the coming of the electric light on kindred industries has been most beneficial. Several of the improvements in mechanical engineering can be traced to it, while the commercial results are even greater. During the last ten years, one firm of engine-builders—the Armington & Sims Company—has sent out nearly as many engines to drive Edison dynamos as there were in all the United States fifty years ago.

We have now seen the various portions of an Edison electric lighting plant, with the exception of the lamps and fixtures, in course of preparation for the work they have to do, and it is no more than appropriate that before passing on we should glance at a few details of that work, to meet the growing necessities of which the vast factory we are inspecting was established.



VIEW OF THE MAIN FLOOR OF THE WIRE INSULATING DEPARTMENT, NO. 1 SHOP.

The grand totals of output have already been cited above, with the remark that they justify the opinions and assertions of those who were ready to put the incandescent light in direct competition with gas. As has been said, the triumph of the electric light is the old, old story of genius *versus* difficulty; and now that a backward look is taken, it is realized that the situation required all the hopefulness and cheerfulness with which it

was faced. The inventor has more than his share of sanguine temperament. His eye may not have a frenzied rolling like that of the poet, but he must have enough of the poetic disposition and imagination in him to body out prophetically his ideas in their perfected form, and to see through or over all obstacles to the goal of improvement whither his genius leads him. The progress of electric lighting, and the work of Mr. Edison, of which we are now speaking in particular, exemplify this truth. We were all dithyrambic in our utterances when the light was first brought out, and the sense of victory over very serious hindrances warranted our jubilant expressions; but, on the other hand, there was a tendency to forget that even the best of things has to fight its way in the world, and that in this case the new-comer had not only to subdue the natural conservatism of society but to gain a foothold on ground already occupied by one of the wealthiest industries in the world. So long as an invention remains in its theoretical or experimental stages, it is comparatively easy to be enthusiastic as to its future; but when we get it in the concrete and witness it encountering the shocks of competition and criticism, it is impossible long to see it other than it actually is. We have then the satisfaction of learning that our faith was well founded or the mortification of knowing that our hopes were vain. Prof. Henry once said that two conditions were necessary to the success of an important invention; first, the scientific principle on which it is to be founded must be known, and, second, it must be wanted by the exigencies of the time; and he added: "The man of true genius never lives before his time; he never undertakes impossibilities, and always embarks in his enterprise at the suitable place and period. Though he may catch a glimpse of the *coming light* as it gilds the mountain top long before it has reached the eyes of his contemporaries, and though he may hazard a prediction as to the future, he *acts* with the present." Taking these felicitous sentences as a test of the sanity of their enthusiasm, those of us who assisted at the introduction of the electric light may claim to be fully vindicated. The electric light is not merely based on scientific principles, but thoroughly accords with all that is scientific in modern ideas of safety, purity and cleanliness. It was called for by the intelligence of the times, whose comfort and convenience it so amply meets; and the men first to proclaim its merits and its desirability, and to act on their beliefs, have seen their every prediction realized to a striking degree within a decade.

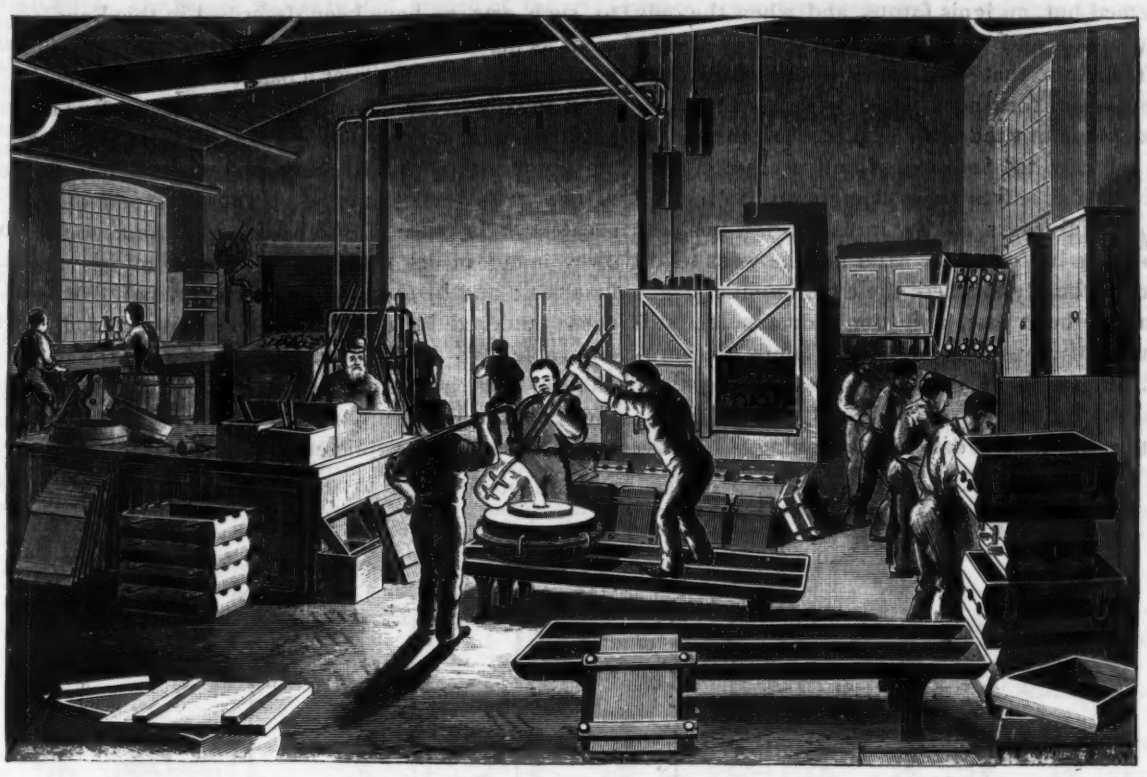
Every machine building in these Works points the moral. Just about six years ago, after the demonstration at Menlo Park, where upward of 1,000 lights were distributed over an area of a mile square, the Edison Electric Illuminating Company, of New York City, had installed its plant and system for service in a district of about the same size, with a network of about 79,000 feet of underground conductors, answering to the description given on another page. It was an anxious season, and, of course, the ready pessimist improved the occasion. "Mr. Edison has just met with the greatest disappointment of his life," said a writer in one of the leading gas journals, "the complete failure of his attempt to light 2,500 houses by his underground system of wires. But fifty houses could be lighted, the electricity being conveyed away owing to imperfect insulation." The wish was father to the thought but not a relative to the fact. To-day the station started in this city in 1882 is still in operation, and as we look around the big machine shop where the dynamos are constructed, we are reminded at every turn of the extension that the business has enjoyed. The Pearl street station was a notable installation in its day, and has its place in the history of the art, but one needs only to visit it to become informed as to the advancement that has been made, and that is illustrated also by these machines around us for the new stations in New York, Chicago and Philadelphia. With the equipping of Pearl street station began that part of the operations of the Machine Works. In 1883 the dynamos were supplied for the central station at Roselle, N. J., on the two-wire system, and then a little later that year were built those for the first station on the three-wire system at Sunbury, Pa. Now the list of stations began to lengthen, with Brockton and Fall River in Massachusetts, Piqua, Circleville, Tiffin and Middletown in Ohio, and Mt. Carmel, Ashland and Shamokin in Pennsylvania. Up to the present time, the Works have built machines for no fewer than 140 stations in this country, as stated before. These stations are to be found in all parts of the Union, utilizing every kind of prime power, from crude petroleum and natural gas to waterfalls and artesian wells, in addition to steam engines of all the well-known and approved makes. The Works have latterly been required also to furnish dynamos of the Municipal type, giving an electromotive force of 1,200 volts, for street lighting plants, such as those at Rochester, N. Y.; Denver, Col.; Lockport, N. Y.; Reading, Pa.; Somerville, Mass. The Lockport plant was started as long ago as 1885 by the local gas company, which says: "We find that whether for streets or for interiors the sale of electric light is more profitable to us than gas."

VIEW IN THE BLACKSMITHY.

It is in connection with this central station business that a remarkable development affecting the Works is going on. Slowly but surely the stations are getting upon their proper basis of supplying current, not simply for lighting, but for all the other demands that may arise for it. A station is no longer a place where intense activity for five or six hours is succeeded by leisure and dullness the rest of the twenty-four. The telegraph office, requiring current for its circuits; the telephone exchange, with its magnetos to be run; the medical establishment, with patients to be cured by electricity; the printing offices, the ice cream saloons, the buildings with elevators, the wood-working factories, the chemical works with bad ventilation, the jeweler's workshop, the clothier's store—each of these and hundreds of other places need current all day long for direct use or to drive motors, and they are all becoming customers of the central stations. The Edison Machine Works have within the last year, besides building a large number of special generators, sent out thousands of horse-power of Sprague motors to these stations, and the tasks to which the motors are put multiply daily. To Laramie motors have gone to operate a large flouring mill and a rolling mill. At Hutchinson and Abilene, in Kansas, as well as at Detroit, the motors are printing daily papers, and they are also running newspaper presses at Elgin, Ill.; New Brunswick, N. J.; Cincinnati, O., and other places. At Des Moines, Ia., the motor, with its current from the central station, brushes down the horses, while at Pawtucket, R. I., it follows the dusty trade of stonecutting. It is now not at all an unusual thing to go into an office which ought to be hot and there be saluted with a refreshing breeze which comes from one of these motors stowed away with a fan up in some corner. In these and similar ways, the use of motors is so rapidly on the increase that, to go no further, there is already promise that before 1890 all the Edison stations will have been supplied from the Machine Works with motors for day service, up to the limit of their generating capacity, while in several stations an increase in plant will have been rendered necessary by the demand for electric motive power. The significance of this development is quite beyond estimation.

So much for the great central stations of the day, as here illustrated by the work doing on their account. The record is impressive, but it has a counterpart in the output of machines for isolated lighting. At this moment there are not far short of 1,500 isolated Edison plants running in the United States alone. The first commercial plant of this kind is said to have been that installed on board the steamer "Columbia" for the Oregon Railway and Navigation Company in 1879. Now over 90 steamships, yachts, ferryboats, men-of-war and other craft in our waters enjoy the light—such craft as Jay Gould's "Atalanta," James Gordon Bennett's, "Namouna," and William Astor's "Nourmahal," being on the list, in company with the noble Sound steamer "Pilgrim" and the gorgeous "Monmouth;" the war ships "Trenton" and "Dolphin." The Works have also built dynamos for a number of foreign vessels in the different navies, as well as in the mercantile marine. Several of the dynamos now in hand are for mills and factories, and some conception of the vogue enjoyed by the light among manufacturers and others may be formed when we state that the Works have furnished machines for more than 160 cotton, woolen and textile fabric mills; nearly 70 flour mills and grain elevators; just upon 100 iron works, car shops and machine shops; over 60 furniture and other woodworking establishments; about 100 miscellaneous factories, etc.; more than 50 newspaper and publishing offices; some 70 asylums and public institutions; a round 50 theatres and places of amusement; nearly 250 banks, clubs, apartment houses, office buildings and fine residences; and paper mills, oil refineries, pumping stations, special works and the like to the number of 300 or 400 more. Such figures explain of themselves the activity which we have already noted as so characteristic of the Works. Some of these plants are, in fact, larger than an average central station and often include half a dozen dynamos. Thus the plant of the "Dakota" apartment house and the streets adjoining, in this city, is of 5,000 lights capacity. That of the beautiful Hotel Ponce de Leon and Alcazar, at St. Augustine, runs up to 4,100 lights. The isolated plant of the Astor building in Wall street, this city, is used for nearly 1,400 lights; the Custom-house at New Orleans

has 1,200; the new "Rookery," at Chicago, represents 4,000. A recent order received at the Works is for dynamos to operate what will be when finished by far the largest isolated plant in existence, that of the new Auditorium in Chicago. Among the mills, there are a great many big plants, to which from time to time a new machine is added. The success of the electric light in the mills has been perhaps as pronounced as anywhere else, and a trip by night through New England reveals building after building brilliant with the electrics flashing into sight, until it looks as though no other illuminant were known or tolerated by the busy manufacturers in that section of the country. It may be mentioned that the business of supplying isolated plants was undertaken at first by the Edison Company for Isolated Lighting, in 1881, but since 1886 it has been carried on by the Edison United Manufacturing Company.



THE BRASS FOUNDRY.

Beyond this demand for machines from central stations and isolated plants, there comes a steady flow of orders from abroad. This is one of the facts that speaks volumes for the progress made by America in electrical arts. There is no denying the popularity abroad of American electric lighting apparatus. According to the popular idea, our ingenuity is most typically represented in the export trade by sewing-machines, street cars, axes and Yankee clocks. Well, each of these is a good exemplar in its way of the manner in which, through the ability of its inventors and mechanics, America bids fair to monopolize in time some leading branches of industry, but recognition is certainly due of the preference manifested in Europe and other quarters of the globe for American electrical apparatus. From these Works, for example, machines have been dispatched to regions as remote as Finland, China, Brazil and South Africa. The demand for electric lighting in South America may be said to be wholly met from this country, and the machines undergo all the trials of a long sea voyage as well as the handling of inexpert natives. A large contract filled not long since at Schenectady was for a plant for Tokio, Japan, where light is now being supplied to the Mikado and to a large portion of the city. Even the "hermit kingdom" of Corea has sent orders to the Works.

We are forgetting, meanwhile, two or three other large departments of the Works, namely, the pattern shop, the blacksmithy, the iron foundry and the brass foundry, views of all of which are shown. Owing to the practice which prevails of manufacturing nearly all the new tools and special machinery on the spot, the pattern shop is even larger than might be expected. It has been said that a pattern shop is often at once the graveyard and the tombstone of a manufacturing establishment, but we find here every sign of discreet superintendence. As usual the appliances are the latest and best. Motive power is furnished by a large Edison motor. The blacksmithy offers nothing special for comment, but there is an ingenious system in use in the iron foundry for molding. The cost of the work there has been greatly reduced by a patented process operated by hydraulic pressure, as seen to the left of the illustration. This department was lately leveled to the ground by fire, but has been rebuilt and enlarged with the utmost rapidity to meet the crush of orders. So pressing was the work in the meantime, it was necessary to hire a foundry in the neighborhood. At the period of the writer's visit a great variety of work was in hand, including portions of some of the larger dynamos and a number of pulleys. This work, as indicated above, is taken to the great No. 2 machine shop, and there put through its different finishings. The quality of the work on the dynamos is well known, but it should be here stated that the management of the Works is not less exacting as to the quality of the pulleys and shafting that it sends out. So high is the reputation gained in this special class of product, that orders have come in for it from establishments in some of the most distant States. A quantity of very heavy work was thus seen in progress for one of the new industrial enterprises of the South.

The other buildings are such as pertain to a huge factory of this character, and comprise storerooms, coal and coke houses, wash houses, stabling, gate house, carriage house and gas house. There are also a large drafting room, a supply department, and the offices of the management. A word or two regarding the personnel of the Works is in order. Mr. Edison is the president of the company and Mr. Charles Batchelor the vice-president. The active control is in the hands of Mr. Samuel Insull—long Mr. Edison's private secretary—the treasurer and general manager, seconded by Mr. John Kruesi, the assistant general manager, who has as his aide Mr. W. B. Turner, superintendent of the works. Mr. John Langton, Jr., is the mechanical engineer. The business at the branch office in Dey street, New York, is under the care of Mr. J. Hutchinson, the secretary of the company, who directs matters there when Mr. Insull is absent. The selling department of the shafting business is attended to by H. M. Livor, one of the directors, and the wire selling department is in charge of Mr. James Kelly. The Works have also a depot in Europe, under the charge of Mr. P. S. Dyer, at the Rue de l'Empereur, Antwerp. There is special long distance telephone connection between the works and the New York office—no less than 180 miles.

Some quick work, too, has been done by means of the telegraph, which is also in incessant use. A month or two ago an opportunity was afforded to show how quickly machines could be got out. The Edison station in Boston, it will be remembered, was disabled by fire one Saturday morning. It happened that Mr. Insull was in Boston at the time. He immediately placed himself in communication with Schenectady, and as soon as the requirements of the case were ascertained, ordered a new outfit of machines to be sent on at once. With equal promptness the Works responded to the call. That night the new machines were on their way to Boston, and before Monday morning dawned they were in position and delivering current to the circuits for scores of motors and hundreds of lights. Nothing could more signally demonstrate the ease with which a sudden demand might be met and the facility with which the appliances for generating current can be renewed or replaced.

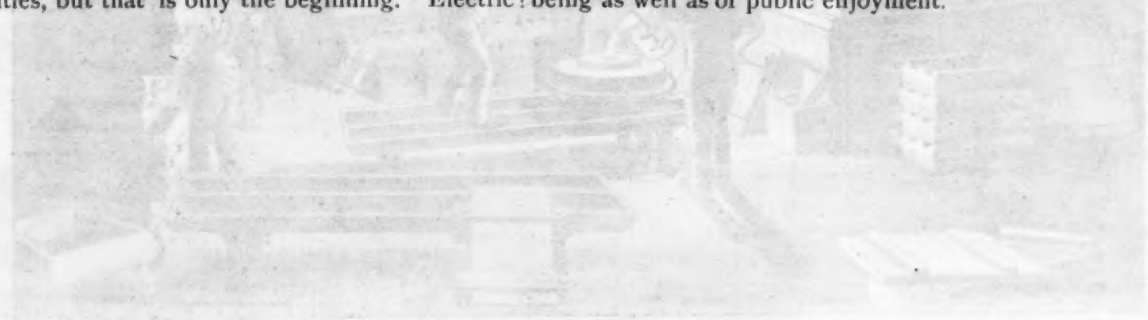
Here we may fittingly bring to a close our description of the Works. There are many matters of interest that have not been touched upon, as there are many additional points of instruction and value that would come up for consideration if space and time allowed. It would have been worth while, for instance, to have followed out the evolution of the dynamo as it was first built by the Works and as we find it to-day; and it would have been equally valuable to have compared its improvement with that of, say, the steam engine or the loom. Other lessons perchance might have been drawn from the study of the methods devised for the production of the machinery. But the main fact has, it is believed, been made clear, namely, that in electric lighting a gigan-

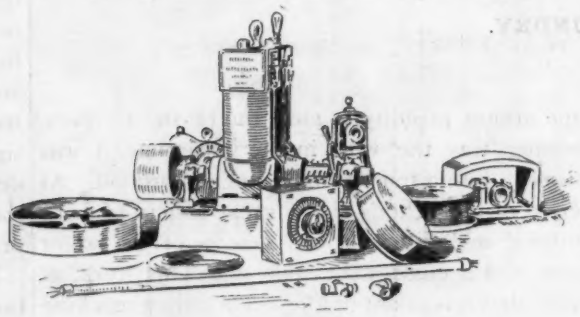
THE IRON FOUNDRY AND HYDRAULIC MOLDING MACHINE.

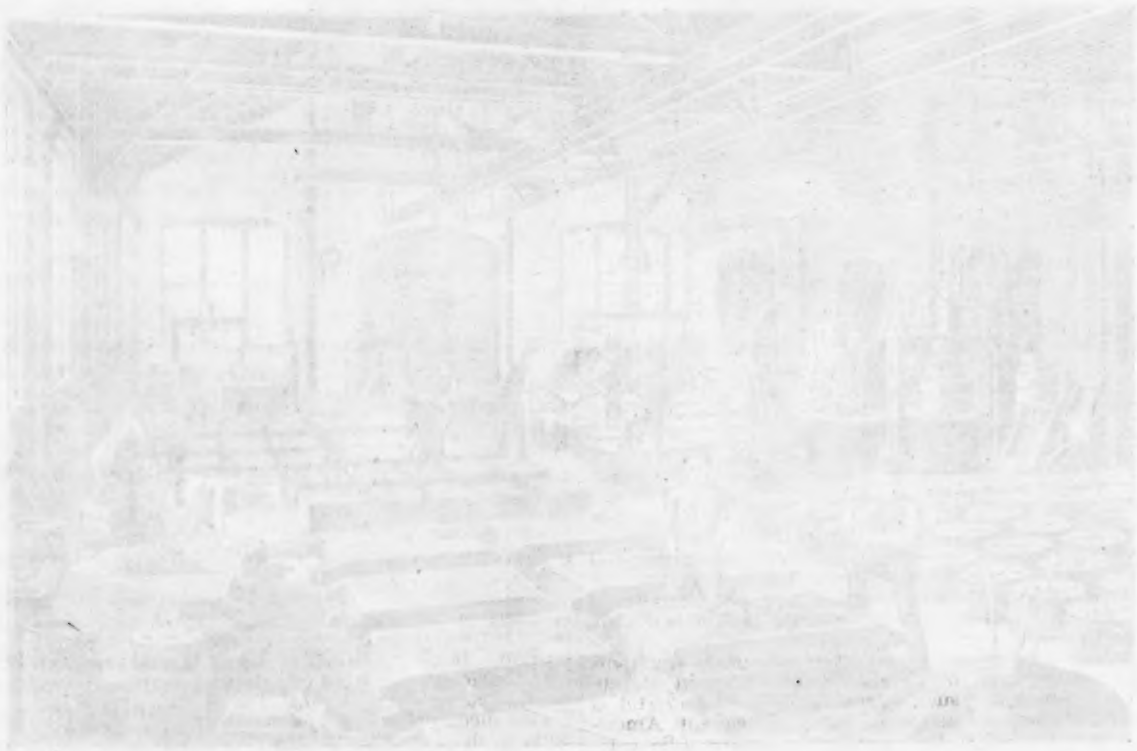
tic and growing industry has been created. No one can go through such an establishment without realizing profoundly the stability and magnitude of the art to the furtherance of which all its resources are devoted.

The boldness and the success with which so important an undertaking was called into existence by Mr. Edison do credit very strikingly to his business capacity. In all probability, on ordinary narrow business lines, he would be very much of a failure, just as we can conceive that Mr. Gladstone, the leading financier of England, would not shine as a bookkeeper; but gauged by large principles of enterprise and forethought, Mr. Edison has won his right to the title of a "captain of industry" in its full meaning. He is not only the animating spirit of this establishment, but is actively interested in the Edison Lamp Company, at Harrison, N. J., with a factory turning out from 5,000 to 10,000 lamps per day, and in Bergmann & Co., in New York, where 500 men are employed in the manufacture of all the various details of the lighting system that relate to regulation, safety, control, measurement and decorative display. All these great industries are based on upwards of 500 patents owned by the Edison Electric Light Company, whose president is Mr. Edward H. Johnson, for very many years past closely connected with both the scientific and the commercial development of Mr. Edison's inventions. We take it that in being thus the mainspring of such vast industries Mr. Edison finds his old wish to furnish employment to others realized, and is rewarded thereby for the perseverance of the early years of discouragement, when the incandescent light seemed but an ignis fatuus, and when the only net gain for toil and weariness was the proof of Mr. Ruskin's dictum, that "Patience is the finest and worthiest part of fortitude."

As likely as not the visitor who reached the Works early in the day to find everything at the highest pitch of activity, leaves them at night still in the full tide of productiveness, for the inrush of new business allows of little lull or rest. After all, the work to do has been but barely touched, the experimental stages have scarcely been past, and the pioneers are still among us. Millions of incandescent lamps are burning, and thousands of dynamos are throwing their currents into the mazes and miles of circuits of our great cities, but that is only the beginning. Electric motors are now in use everywhere, but their number for power purposes is to increase in a geometrical ratio for years to come, and their superiority for urban passenger traffic is only just across the threshold of its triumphant demonstration. "Of what use is it?" asked our shrewd Philadelphian forefather, when some one doubted the value of his identification of lightning and electricity, "what is the use of a child? It may become a man." To-day we are able to point to such arts as have been described in this Supplement as his vindication, and as that of another who has assuredly had as great a passion as he for experiment and discovery. And as we take a farewell of the establishment, we may fittingly recall and apply the panegyric uttered by Mr. Samuel Smiles in his *Self Help*: "Inventors have set in motion some of the greatest industries of the world. To them society owes many of its chief necessaries, comforts and luxuries; and by their genius and labor daily life has been rendered in all respects more easy, as well as enjoyable. * * * Mankind at large are the happier for such inventions, and are every day reaping the benefit of them in an increase of individual well being as well as of public enjoyment."







The Alternating Current Decision in Boston.

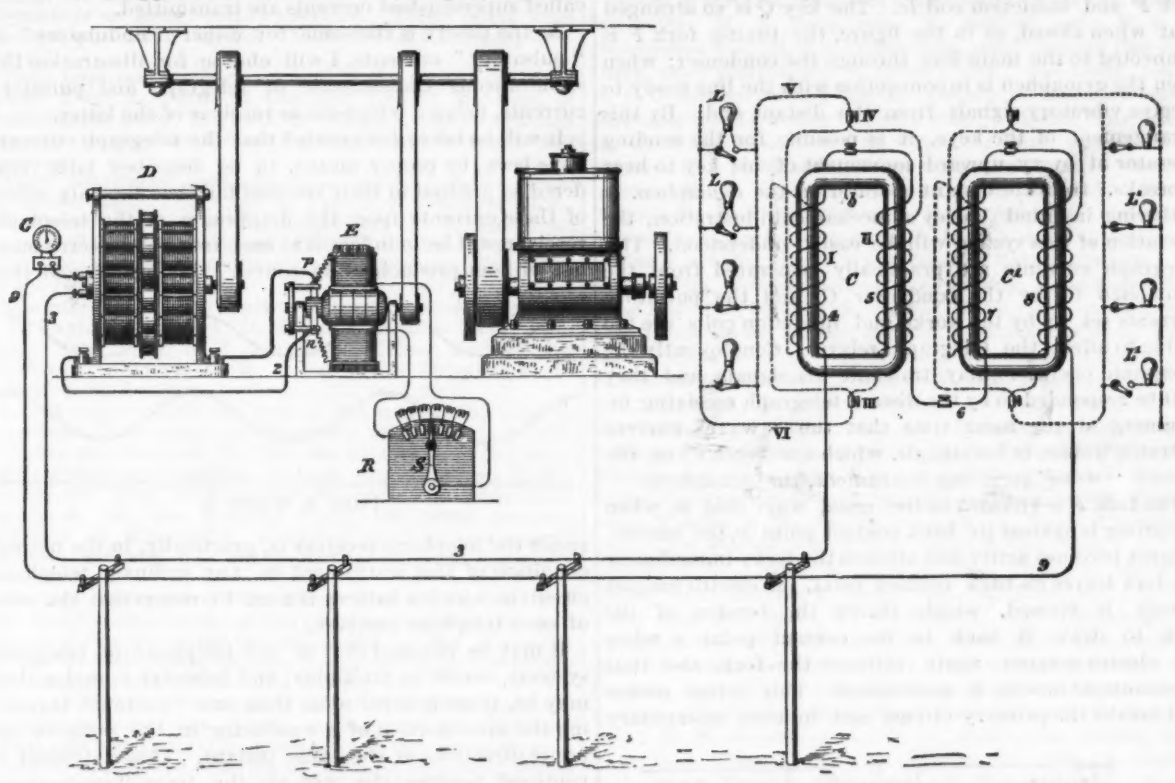
CIRCUIT COURT OF THE UNITED STATES, DISTRICT OF MASSACHUSETTS, IN EQUITY.

Westinghouse Electric Company vs. Sun Electric Company, et al. No. 2,377.

Opinion of the Court. Aug. 7, 1888.

Colt, J.: This suit is brought to enjoin the defendants from infringing letters patent No. 351,589, granted October 26, 1886, to *George Westinghouse, Jr.*, assignee of *Lucien Gaulard* and *John D. Gibbs*, for improvements in methods and apparatus for the distribution and conversion of electric energy.

The case has been thoroughly and ably represented on both sides. The patent relates to that branch of the art of electric lighting known as the incandescent. The specification states that the "invention relates to the distribution of electrical energy for industrial purposes; and it consists in an improved art or method and an organization of apparatus, whereby the same is carried into effect, by means of which we are enabled to transmit from a central or supply station, through a main conductor, a primary electric current of comparatively small quantity, but of high potential, and at a point or points more or less distant, where the said electric energy is to be utilized, to transfer the energy residing in such primary current of high potential into one or more secondary currents of lower potential, but of greater quantity. * * * At a point where the electric current is to be utilized for any suitable purpose—as, for instance, in one or more incandescent electric lamps—we place one or more secondary generators or converters as shown at *C*, in Fig. 1. The general principle of our secondary generator is analogous to that of the well-known inductorium, or induction coil, with this exception, that while the induction coil has heretofore usually been employed to transfer electric energy from currents of low potential and great quantity into currents of high potential and small quantity, the function of the secondary generator or converter, as applied in our invention, is precisely the reverse of this, namely, to transfer electric energy from currents of high potential to currents of low potential and increased quantity. We have constructed converters for effecting this result in a variety of forms, all of which involve the same principle. The most important and characteristic feature of our invention is that which renders it possible to make use of alternating and equal positive and negative currents of moderate quantity, but of very high potential in the primary or main line circuit, and to convert these into secondary or induced currents of much greater quantity, but of correspondingly lower potential at the place of consumption, which secondary circuits are employed to do the required work. Any required number of converters of the general construction described may have their primary circuits united with or included in the conductors leading from the primary generator. The manner of connecting such converters, whether in series, multiple arc, multiple series, or otherwise, will be understood by those skilled in the art to which our invention relates without the necessity of further explanation."



CONVERTERS IN SERIES: FIG. 3 OF PATENT NO. 351,589.

The specification then says that one arragement is indicated in Fig. 3 of the drawings, which shows an arrangement of converters in series. Then follows this disclaimer: "We do not herein claim the connection of the converters in the line in any other arrangement than we have illustrated in the drawings." Fig. 3 of the drawings shows an arrangement of converters in series. The defendants connect their converters in what is known as the multiple arc system, which is quite different in construction and mode of operation from the series system.

There are five claims in the patent, the first being for the art or method, and the remaining four claims for the apparatus.

The first question which arises relates to the proper interpretation of the patent in view of the disclaimer. Undoubtedly, as originally drawn, the patent was intended to cover all forms of converters which transferred electric energy from currents of high potential to currents of low potential and increased quantity, whether connected in series, as indicated in Fig. 3 of the drawings, or in multiple arc or otherwise. The Patent Office refused to grant so broad a patent and instructed the applicants that, in order to avoid an interference they must confine the arrangement of converters to the series system, that being the arrangement shown in the article in *Engineering*, of March 2, 1883, which the applicants declared contained a description of their invention. Thereupon the disclaimer was inserted. An examination of the file wrapper and contents discloses that the patent office believed this patent should be limited to the arrangement of converters in series, and that this was supposed to have been effected by the disclaimer; otherwise an interference would have been declared. The patentees avoided such interference by inserting the disclaimer, and it is too late now to say that the disclaimer means in effect nothing. If we construe the patent to cover broadly a dynamo producing alternate currents of high potential with a single reducing converter, then the disclaimer is meaningless, because such construction would embrace converters connected in multiple arc or otherwise.

The patent states that the invention is for a system of electric distribution; the true scope, therefore, of the invention is not confined to one converter, but to several converters arranged in a system, and, when the patentees disclaim all systems but the series, they should be held to it.

As we have said, Gaulard and Gibbs declare that the invention covered by the patent in suit is found in the article in *Engineering* of March 2, 1883. The defendants deny that the article describes converters which transform the current from high potential to low. Whoever may be right, it appears quite certain that the high potential of the primary, and the low potential of the secondary, or the long thin primary wire and the short thick secondary wire, which become so important in the patent under consideration, are not specifically described or shown with clearness in the article in question. The system described in the article was a general one, and was intended to meet the conditions laid down in the English Electric Lighting Act, which provided that the "undertakers" shall not prescribe to householders and others, to whom they supply the current, the use of any particular kind or form of lamp. The Gaulard & Gibbs invention has a two-fold object, says the article: "Firstly, it aims at rendering it practicable for undertakers to supply current at the most economical potential permitted by the terms of their provisional orders; and, secondly, it is intended to make the user independent of the producer, and to enable him to apply the current he receives to any purpose he may please, such as arc lighting, incandescent light, the generation of power or of heat." If the article does show a converter which transforms electric energy from high potential to low, it is evident that Gaulard and Gibbs did not at this time regard this as a great discovery, or it would have been more clearly indicated. Undoubtedly, the article was intended to outline a general system to supply to customers currents of high or low potential as might be desired by means of converters connected in series based upon the principle of the Ruhmkorff coil, but that this was to be accomplished by means of a primary current of high potential and secondary currents of low is not apparent.

Further, if the reducing converter, now made so important, was discovered by Gaulard and Gibbs, in March, 1883, and constituted such a great invention, why did it not form the subject matter of their subsequent American patent of April 29, 1884, and British patent of Sept. 13, 1882?

These things go to prove that the prominence given to the reducing converter in the patent in suit was based upon something else than the article in *Engineering*. I am led to think that it was based upon the fact that, between the date of the article and the date of the patent in suit, other inventions had come to light, and that it was these improvements which induced Gaulard and Gibbs to set up the claim they make in their last patent.

In the patent granted to E. Thomson, July 14, 1885, the converters are arranged in series. The object of the invention was to provide a safety switch for the converters, but we there find described the primary or main current of high potential and the secondary current of low potential. The specification says: "The secondary coil is wound with such coarse wire, and the lamps used therewith are of such low volt potential as not in itself to produce dangerous discharges or shocks." Thomson seems to take it as a matter of course, in view of the prior state of the art, that there was no invention in reduction from high potential to low through a converter.

But the most important improvement was made by Zipernowsky and Déri in their English patent of March, 1885. This patent describes minutely a system of distribution by induction through potential-reducing converters combined in multiple arc, and it includes an alternating-current dynamo generating a current of high potential.

We see then that the state of the art in 1882, when the article in *Engineering* was written, and in 1886, when the patent in suit was issued, was quite different. It became very important, therefore, for Gaulard and Gibbs to obtain a patent for a single reducing converter, however it might be combined with others in a system. I think the importance given to this point in the patent, an effort to expand the real invention of Gaulard and Gibbs, as contained in the article in *Engineering*, and that the patent office intended and did in effect limit the patentees to all they were fairly entitled to, namely, the arrangement of their converters in series in a system of electric distribution.

By assuming that our interpretation of the effect of the disclaimer is wrong, and that Gaulard and Gibbs are entitled under their patent to claim the exclusive right to a converter which transfomrs energy from high potential to low in combination with a dynamo producing alternating currents, can so broad a claim be sustained in view of the prior state of the art?

To uphold this position, of course, Gaulard and Gibbs have to go back to the article in *Engineering*, of March 2, 1883, as the date of their invention, because this form of converter in combination with an alternating dynamo is clearly shown, as has been observed in the Thomson and Zipernowsky and Déri patents of 1885. But, admitting that the date of the invention was March 2, 1883, I have much doubt whether Gaulard and Gibbs could obtain a lawful patent for so broad a claim. The counsel for the plaintiffs in his closing argument admits that the induction coil or inductorium or converter, in its general sense, as a device used for taking off from the line at different points a portion of the electric energy, whether of the same or higher or lower potential, was well known. The article in *Engineering* states that the secondary generator or converter was based upon the same principle as the Ruhmkorff coil. In the English patent granted to Paul Jablochkoff, Nov. 9, 1877, we find described a system for producing and dividing electric lights which consisted in carrying a main alternating current round an unbroken circuit and transferring its energy by means of induction coils to consumption circuits at the points where it was to be used. The converters are placed in series with one or more lamps in the secondary of each converter. But it is said that Jablochkoff contemplated a conversion from low to high potential, the reverse of Gaulard and Gibbs. At the same time it was well known that the converter would transfer energy from high to low, or low to high, as the primary wire was longer or shorter. Was it invention for Gaulard and Gibbs simply to reverse the coils and transfer the energy from high to low?

In the English provisional specification of Edwards and Normandy, Nov. 13, 1878, the inventors propose to use either interrupted or alternating currents with a converter near every place where the light is to be produced. The specification says: "At or near every point where it is required that a light shall be produced, we arrange a coil (or series of coils) of insulated metallic wire or ribbon (preferably surrounding a bar or wires of soft iron), through which coil or coils the current from the principal wire first described can be passed when desired, or cut off by means of a key or lever. Round or adjacent to each coil of insulated wire described, we form one or more secondary coils of insulated metallic wire or ribbon, arranged so that the passage of the rapidly intermittent current of electricity, as described, through the primary coil or coils generates a corresponding amount of electricity in each of the secondary coils. In order to facilitate the production of the induced electricity, *and to diminish its intensity and increase its quantity*, we prefer making the coil or coils in which the electricity is induced of a number of insulated wires or ribbons made up into a bundle or rope, the ends of the wires or ribbons at each end of the bundle or rope being in metallic contact with each other, which united ends are then joined to the conductor, conveying the induced electricity." Here is found distinctly stated the principle of a reduction from high potential in the primary to low potential and increased quantity in the secondary, which Gaulard and Gibbs assert is their great discovery.

The patent to J. B. Fuller, Nov. 26, 1878, is for an improvement in induction apparatus for lighting by electricity. This invention embraces converters arranged in series like those of the patent in suit to be operated upon by an alternating current. It is not stated whether the potential is to be raised or lowered in the converters, but the drawings appear to indicate that it was to be raised.

In the English provisional specification of J. H. Johnson, Dec. 24, 1878, while the inventor contemplated the raising of the potential in his converters, yet he says, "the apparatus may be connected together * * * in such manner as to augment either the tension or the quantity of the current."

Thomas A. Edison took out a patent May 28, 1883 (the application having been filed Aug. 14, 1882), for an apparatus for translating electric currents from high to low tension. In his invention he uses a continuous current of high tension in the main circuit, and reduces it to a continuous current of low tension in the secondary circuit.

This incomplete review of the prior state of the art would seem to show that at the date of the article in *Engineering* there was no invention in a single converter which transferred energy from high to low potential, as distinguished from a conversion from low to high. It seems to have been assumed in prior patents as a matter of common knowledge that, by the laws governing the inductorium or converter, the electric force transferred could be either of the same potential or of greater or less, as might be desired. It required something further, something that might be called invention, to solve the problem of a successful system for electric distribution. Gaulard and Gibbs undoubtedly believed that, in the article in *Engineering*, they unfolded to the world a description of a successful system. So far as their system was a new invention, and is found incorporated in the patent in suit, they are entitled to be protected. But they are expressly limited by their disclaimer to the series system, and, therefore, the defendants who use the multiple-arc system do not infringe.

Without entering further into the defenses raised, I am satisfied, for the reasons given, that the bill should be dismissed.

Bill dismissed.

Telegraphy with Superposed Pulsatory and Undulatory Current Signals.—I.

BY WM. MAVER, JR.

It is proposed, in this article, to describe and briefly comment upon certain systems of simultaneous telegraphy and telephony and also several methods of simultaneously transmitting Morse telegraph signals and telegraph signals in which momentary or pulsatory currents are employed; which latter currents, as compared with those used in manual Morse telegraphy, may be considered practically analogous to those employed in the electrical transmission of speech, except as regards the degree of strength of current and the manner in which they are respectively produced.

In what follows it may be convenient to refer to the current employed in ordinary Morse telegraphy as the "telegraph current"; and to that used in systems of telegraphy employing momentary or pulsatory currents as the "pulsatory" current.

As the term may imply, simultaneous telegraphy and telephony consists in the transmission of articulate speech and telegraphic signals on the same wire or wires at the same time; on one wire if the telephone system is operated on a "grounded" circuit; on two wires if on a metallic circuit. In the latter case there would be the simultaneous operation of two telegraph circuits and one telephone circuit, the telephone circuit utilizing both of the telegraph circuits. The same is true of simultaneous Morse telegraphy and "pulsatory" current telegraphy.

The discovery that simultaneous telegraphy and telephony was possible, is generally attributed to Prof. Van Rysselberghe, presumably because of the fact that the Van Rysselberghe system of simultaneous telegraphy and telephony is the only system of this kind in extensive practical operation. But he does not, I believe, claim this honor, simply asserting that he makes simultaneous telegraphy and telephony practicable by the application of certain devices to the telegraph portion of the system. That discovery was probably first made by the late Cromwell F. Varley, the eminent English electrician, who, in 1870, showed, or at least indicated, that pulsatory

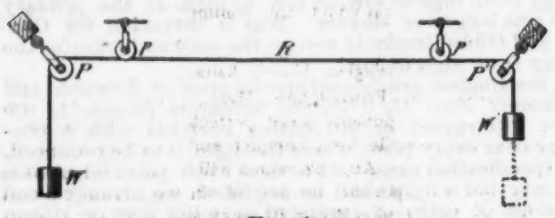


FIG. 1.

or undulatory currents of electricity could be superposed upon telegraph currents without detriment to the latter. That is to say, that simultaneous telegraphy and telephony, or systems akin thereto, was possible.

In describing the invention, Mr. Varley used an ingenious mechanical illustration, which will, I think, convey to those not already familiar therewith a fair general idea of the theory of the operation of such systems, and, therefore, I quote it in full, supplying a diagram, Fig. 1, to accompany the illustration: "As a rough mechanical illustration of the way in which I propose to pass two sets of signals simultaneously and in either direction through the same line wire without interference, I will suppose a rope *R* stretched over two distinct pulleys *P P'* by means of weights *W W'* at each end. With such an apparatus, if the near weight be raised, the distant one falls, and in this way signals may be transmitted by the connecting rope, which may be called (telegraph) current signals. If, now, two small pullies *p p'*, capable of rising and falling, rest upon the rope between, but near to, the supports, they will simply rotate when the pulley is shifted backward and forward, but if, now, an operator at one end strike the rope, vibrations or waves will be produced and will cause the small pulleys to dance, and so vibration signals will be given. Consequently the operator who shifts and the one operator who strikes the rope can each produce independent signals on one and the same communicating cord."

The strained wire and sounding-board, as described by Varley, were specified to be about 5 feet in length, and instruments of that size will operate fairly well, but instruments of a much smaller size are a decided improvement, and a modern telephone receiver or a tuned reed is still better. In passing, it may be said as an example of the truth of the statement that almost anything will act as a telephone receiver, that a sounding-board arrangement, such as Varley describes, but reduced to about one foot in length, will reproduce speech tolerably well.

One of numerous means which Mr. Varley suggested to produce the vibratory currents consisted of the well known magnetic tuning fork circuit breaker and induction coils, shown in Fig. 3. One of the instruments designed by him to receive the vibratory circuit he termed a cymaphen. The cymaphen consists of a helix *S*. Fig. 2, through which runs a strained wire *W*. Permanent magnets *M M'* are placed above and below the helix, the poles of which are in close proximity to the strained wire, as shown. The wire is supported on a large sounding-board, and the whole is encased in a substantial wooden frame. The vibratory currents passing through the helix set up magnetic vibrations in the strained wire, in consequence of which it is alternately attracted to the upper or lower magnets, according to its magnetic polarity. By suitable devices the strained wire is adjusted to vibrate in harmony with the note of the transmitting fork, so that when it is thrown into vibrations it produces a musical note corresponding to that of the tuning fork, the sound of which is increased by the sounding-board. As long as the vibratory currents from the tuning fork are permitted to pass into the line wire the sounding-board will give out the note, and when the currents are cut off from the line the strained wire ceases to vibrate. To produce Morse

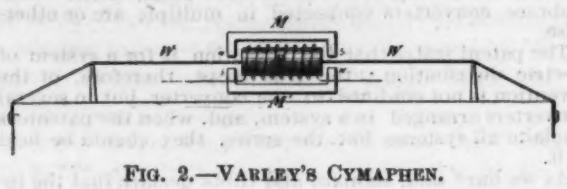


FIG. 2.—VARLEY'S CYMAPHEN.

signals it is only necessary then to use a key which will interrupt the vibratory current from the induction coil, and by opening and closing that key for a long or short interval, a long or short sound, corresponding to a dash and dot, is produced.

Fig. 3 shows the general plan invented by Varley to carry out electrically the foregoing mechanical illustration. The key *K*, battery *B*, relay *R* and rheostat *T* constitute the apparatus of the duplex telegraph system. *I* is a helix with movable core composed of small iron rods, the function of which will be mentioned further on. *C* is a condenser, one of whose terminals is attached to the main line, the other to the cymaphen *Cy* or the vibrating fork *F* and induction coil *Ic*. The key *Q* is so arranged that when closed, as in the figure, the tuning fork *F* is connected to the main line through the condenser; when open the cymaphen is in connection with the line ready to receive vibratory signals from the distant end. By this arrangement of the keys, it is possible for the sending operator at every upward movement of his key to hear "breaks," from the distant operator on the cymaphen.

Having in mind Varley's mechanical illustration, the operation of this system will be easily understood. The telegraph currents are practically separated from the cymaphen *Cy* by the condenser *C*, and the pulsatory currents set up by the forks and induction coils are too feeble to affect the telegraph relays. Consequently the telegraph operator may transmit his signals, and they will be responded to by the distant telegraph receiving instrument at the same time that the "wave" current operator transmits his signals, which are received on the distant "wave" receiving instrument, the cymaphen.

The fork *F* is vibrated in the usual way; that is, when the prong is against its back contact point *x*, the electro magnet becomes active and attracts the fork; immediately the fork leaves its back contact point, the electro magnet circuit is opened, which allows the tension of the fork to draw it back to its contact point *x* when the electro-magnet again attracts the fork, and thus a continuous motion is maintained. This action makes and breaks the primary circuit and induces momentary

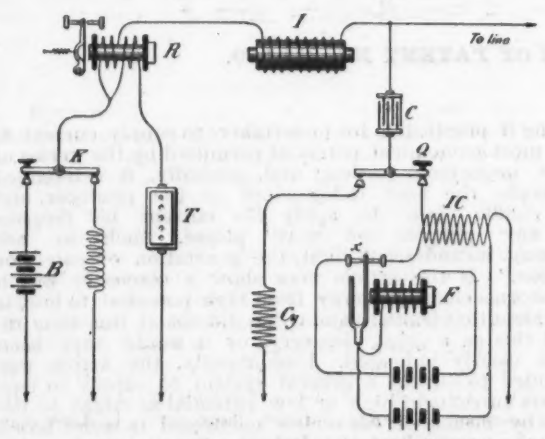


FIG. 3.—VARLEY'S DUPLEX SYSTEM.

currents in the secondary coil which are transmitted over the line when key *Q* is closed.

Varley also describes a plan for utilizing this arrangement on single wires, which he proposed to do by shunting the relays in the main line circuit at the different stations with condensers, which latter would inductively carry the pulsatory currents past the electro-magnets in the circuit.

As far as I can ascertain, this arrangement was never put into practical operation by Varley. Like other of Varley's inventions or suggestions, however, that have in later days been put to practical uses, this device, or its equivalent, is now used by several fire alarm telegraph and police departments in some cities as an excellent method of communicating by telephone between stations without danger of interfering with the sending of fire or burglar alarm signals; and, as will be seen later, several of its principal features are also employed in other forms of simultaneous telegraph and pulsatory current systems.

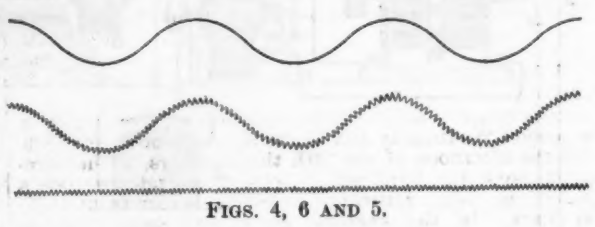
It is well known that when a telephone receiver is inserted in an ordinarily equipped telegraph circuit, very disagreeable noises are heard in the former when the telegraph signals are being transmitted, and it will be apparent that no system of simultaneous telegraphy and telephony could be made operative that did not in some way obviate this noise in the telephone receiver. With a receiver such as that of Varley's, already described, while the effect of the telegraph signals would not be as marked as in the modern telephone, still it might be sufficient to render the signals somewhat variable. There is no indication in Varley's patent covering this system of simultaneous telegraph and pulsatory current that he anticipated any difficulty or interference from this cause. He seems rather to have assumed that if trouble were to be caused by superposing pulsatory or "wave" currents on the telegraph wire it would be the telegraph system that would suffer. Varley, however, described a device consisting of an electro-magnet (*I*, Fig. 3), having a resistance of about six or eight hundred ohms, which was to be placed in the line wire. This device would be very effectual in preventing the telegraph currents from being felt in the cymaphen, inasmuch as it would render the rise and fall of the telegraph currents so gradual that they would not be harmfully felt in the cymaphen, nor indeed in a much more sensitive receiver.

Varley's intention in devising this apparatus was, he states, to prevent the effects of the static induction of the line from interfering with the duplex telegraph signals; and, it may be added, that modifications of this device have at different times since been re-invented and used in duplex working as "static compensators."

Before entering into a description of various other systems of simultaneous telegraphy and telephony, and of simultaneous telegraph and pulsatory current signals, it may now be well to consider the manner in which so-called superimposed currents are transmitted.

As the theory is the same for either "undulatory" or "pulsatory" currents, I will choose for illustration the simultaneous transmission of telegraph and pulsatory currents, using a telephone as receiver of the latter.

It will be taken for granted that the telegraph currents have been, by proper means, to be described later, rendered so gradual in their rise and fall that the only effect of these currents upon the diaphragm of the telephone receiver will be to inflect it to and from the electro-magnet without producing any sound. Having effected that



FIGS. 4, 6 AND 5.

result the telephone receiver is, practically, in the normal condition of that instrument in any ordinary telephone circuit in which a battery is used to magnetize the core of such telephone receiver.

It may be assumed that in any telephone or telegraph systems, simple or multiplex, and however complex they may be, there is never more than one "current" traversing the same portion of a conductor in the same or opposite directions at the same instant. This statement is ventured because the use of the term "superposed" currents has, to my knowledge, conveyed the idea to some non-technical people that such currents are passed over the wire in either direction, regardless of the telegraph current, and because others have received the impression that in some peculiar and undiscovered way the signaling currents of multiplex systems—for instance, the quadruplex system, whereby four messages are simultaneously transmitted—pass each other on the same wire as if each particular signal or message were allotted a certain portion of the conductor in some such way as four railway trains pass simultaneously over the same portion of the roadbed of a four-track road.

Assuming that the telephone receiver is inserted directly in the telegraph circuit, let us suppose that the strength of the telegraph current which is being used to transmit Morse signals is one ampère, in a positive direction. This attracts the armature of the telegraph relay with a strength we will say of 1, and the signal is recorded. At the same time the diaphram of the telephone will be attracted to the core by a similar strength of current, but as the telegraph current has been rendered gradual, no signal is heard in the telephone. Now assuming that one pulsation of the pulsatory current is thrown on the line, having, we will say, a strength of one thousandth of an ampère, also in a positive direction. This suddenly increases the total strength of current to 1.001 ampères, an increment which, of course, will have no appreciable effect on the telegraph relay, but which will momentarily impel the diaphragm of the telephone rapidly forward. The next pulsatory current, it is assumed, will be in the negative direction. This will have the effect of diminishing the total current strength to .999 ampère, not enough to be felt in the relay, but sufficient to permit the diaphragm of the telephone to fall backwards to an extent approximately equal to its previous forward motion, and these vibrations continued reproduce the tone corresponding to that of the transmitting fork.

In the meantime the telegraph currents may be transmitted regardless of the pulsatory or undulatory currents

the diaphragm of the telephone, as already intimated, simply moving forwards or backwards with an undulatory motion, this motion being momentarily abruptly hastened or retarded according as the pulsatory current increases or decreases the total strength of the telegraph current.

It is, of course, understood that when the telegraph current is off the line, as when the telegraph key is open, the pulsatory currents act upon the diaphragm of the receiver with their own strength only.

Fig. 4 represents the assumed motion of the diaphragm under the influence of the telegraph currents alone. Fig. 5 the assumed maximum motion of the diaphragm under the influence of the pulsatory currents, while Fig. 6 represents the motion of the diaphragm under the combined action of the telegraph and pulsatory currents.

A graphic illustration of the movements of the diaphragm in reproducing electrically transmitted speech, would differ from the regular curve representing the pulsatory currents set up by the tuning fork, according to the quality of the voice originating the electrical vibrations.

The Re-Union of Old Time Telegraph Operators and United States Military Telegraph Corps.

The eighth annual re-union of the old time telegraph operators and the United States military telegraph operators was held in Chicago at Hotel Gore on Wednesday and Thursday, the 15th and 16th.

The first of these organizations represents the entire telegraph service of the United States during the first twenty-five years of its existence. In its membership it includes men who handled the first rude instruments at the time of their invention by Morse. Many of the "old timers" at the commencement of the civil war offered themselves to their country's service. These latter were the men who made up the "U. S. Military Telegraphers' Corps."

Their business meeting was held in the parlors of Gore's Hotel. Wm. R. Plum, of Chicago; Geo. C. Maynard, of Washington, and J. E. Petitt, of Chicago, were re-elected respectively, president, vice-president, and secretary and treasurer.

The "old timers" held a business meeting on the morning of the 16th. Col. Chas. E. Taylor, of Frankfort, Ky., was elected president of the association; D. K. Smith, of Kansas City, vice-president, and W. J. Dealy, of New York, was re-elected secretary and treasurer, the office he has held for four years.

The executive board consists of the following members: C. E. Taylor, Frankfort; D. K. Smith, Kansas City; W. J. Dealy, New York; R. J. Hutchinson, New York; Uriah B. Wilson, Denver; J. M. Turner, New Orleans; S. B. Fairchild, St. Louis.

It was voted to hold the next re-union at Louisville on the second Wednesday and Thursday in September, 1889.

On the afternoon of the 16th the members, to the number of about one hundred of both organizations, took a ride on the lake, returning on the cable cars from Jackson Park. In the evening about the same number gathered at Kingsley's, where a most enjoyable and splendid banquet was held. The tables were tastefully decorated.

During the evening Miss Bliss, Miss Richardson and Mrs. Tomlinson presided at the piano and brought back in song to the hearts of the old timers and to the memories of the United States military telegraph men, the scenes and struggles of a quarter of a century ago.

The president then read a letter of regrets and congratulation from Chas. Smith, manager of the Western Union office at Louisville, promising to the association a warm reception at Louisville next year. Letters of regret and congratulation came also from C. E. Taylor, W. B. Wilson, W. G. Fuller, R. D. Hoover, Clarence E. Stump, "Billy" Barr and others. The first toast of the evening was proposed by President Plum, who said as the company arose with glasses in their hands, "Heresis to Prof. Morse, inventor of the telegraph. God gave him to us and after fulfilling his noble mission, God has taken him away." He then called upon Mr. Jas. D. Reid, of New York. Mr. Reid, whose name will go down in history along with that of Prof. Morse, as a veteran in the telegraph business since the discovery of the use of electricity, arose and said: "I propose that the company drink to the health of Mr. A. H. Bliss for the kindness he has shown us in the entertainment he has furnished us." Mr. Bliss protested, and said: "If they would drink to the Chicago Telegraph Association it would be all right." The glasses were touched again, and Mr. Reid proceeded. The next toast was to the ladies, and was responded to by Mr. J. B. Taltavall. Mr. A. H. Bliss, in his proverbially happy way, responded to the toast of the "Army Operators." He referred in glowing terms to the veteran operators of the war and said he defied any one to point to a single instance when one of them failed to do his country's service. The "Boys" was the next toast and was responded to by W. L. Ives, of New York. Mr. Ives also recited "Bingen on the Rhine." The remainder of the evening was spent in social chat and several songs were sung, everybody feeling at dispersion that he had had a most enjoyable time.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, Aug. 20, 1888.

The Sawyer-Man Company.

The Sawyer-Man Company report the closing of a contract of 800 lights increase for the Pratt Institute, Brooklyn, which now has 500 Edison lights installed. They have also secured a 200 plant for the Laurel Hill Chemical Works, of Brooklyn. Their new departure in regard to lamp prices is proving to be a move in the right direction, even beyond their expectations, affording great satisfaction to those interested. Inquiries are coming in from all directions, taking advantage of their offer to exchange sockets for their standard socket, giving the advantage of uniformity to all those using electric lights of whatever system. They are rapidly increasing their output, and are especially turning their attention to increasing the efficiency and life of their lamp, which has been giving such universal satisfaction.

Hewes & Phillips Engines.

The Hewes & Phillips Iron Works, of Newark, N. J., have recently furnished the East River Electric Light Company, of this city, with a 500 h. p. tandem compound engine of the following dimensions and description, viz.: High pressure cylinder, 22 in. bore × 48 in. stroke; low pressure cylinder, 44 in. diameter × 48 in. stroke, both cylinders being steam jacketed. The fly wheel is 24 ft. diameter and 60 in. face, and weighs about 80 tons. This engine is now running at the station of the East River Electric Light Company, foot of East 24th street, New York City, and can be seen in operation every evening from 7 o'clock until daylight in the morning. The engine makes 71 revolutions per minute, and is so noiseless in its operation that it can hardly be heard. For for beauty of design, excellence of workmanship and fine regulation, it is considered one of the finest pieces of engine work in the country, and the Hewes & Phillips Iron Works, of Newark, N. J., most cordially invite the members of the National Electric Light Association to visit and inspect the engine in detail and in operation. The East River Electric Light Company also unite in this invitation.

C. & C. Motors in New York City.

Few people, even among electricians, have any idea of the extent to which small electric motors are in use, and, although I have "kept track" of the business, I was myself surprised when Mr. H. L. Lufkin, of the C. & C. Electric Motor Company, informed me that they alone had some 300 of their motors in New York City. What he said interested me so much that I got him to furnish me a list of the installations. It is given below, and is well worth study. I have stricken out the addresses to save room, but I may say that the large majority of these motors are to be found down town:

Huber & Seefried, restaurant; American Express Co., stamping outfit; H. A. Bang, rest.; C. Gosford, rest.; H. & J. Blenderman, rest.; H. & J. Blenderman, rest.; *Evening Post* Job Office, office ventilation; E. Lanters, rest.; Jas. Duffy, rest.; H. B. Christensen, drying machs.; DeLacy & Co., office vent.; Equitable Life Assurance Co., office vent.; L. Bonet, office vent.; R. H. Hutchinson, rest.; St. Paul's Chapel, organ; Dawsonamel Co., paint mills; Goodwin, Strong & Co., s. machs. (pants); W. H. Rodier, office vent.; John Bostleman, rest.; Niagara Fire Ins. Co., office vent.; H. Peterson, rest.; Conservatory of Music, organ; Oppenheim & Isaac, s. machs., braiding; Dorlon & Schaffer, rest.; Stahl Bros. & Sevine, s. machs.; E. Ferris & Co., elevator; Lowe & Co., printing; Long Island Machine Emb. Co., braiding; Princess of Wales Co., s. machs., carpets; Brush Electric Illuminating Co., blow pipe and vent.; Calumet Club, vent.; *Electrical Review*, vent.; Electric Club, vent.; Fahnestock & Co., vent.; Koster & Bial, vent.; Lotos Club, vent.; Howard & Morse, vent.; J. O'Neill, rest.; U. S. Illuminating Co., vent.; U. S. Illuminating Co., vent.; T. Mundorff, optician, grindstones; R. W. Zundell & Co., vent.; Norman & Dunker, vent.; Blancard & Co., vent.; J. Peiser, vent.; Northwestern Mutual Life Ins. Co., vent.; Chas. Pfizer, vent.; Mather & Wentworth, vent.; N. Y. Stock Exchange, vent.; Ira Perego, vent.; J. F. Scott & Co., vent.; J. N. Ceballos & Co., vent.; G. B. Rolfe, rest.; Shannon, Miller & Crane, vent.; Lanman & Kemp, vent.; R. Kolb, rest.; H. W. Johns Mfg. Co., vent.; W. H. Bennett, vent.; McDougal & Sprague, vent.; W. P. Wight & Co., vent.; Blake Bros., vent.; *Mail and Express*, vent.; J. V. Robins, vent.; Selchow & Righter, vent.; B. F. Coleman, vent.; F. & H. Lemmerman, vent.; I. Abrahams, vent.; Crass & Beguelin, vent.; C. Fanard, vent.; O. M. Fanard, vent.; N. Y. Belting and Packing Co., vent.; C. A. Cheever, vent.; The Okonite Co., vent.; A. Lorsch & Co., vent.; Henry & Frank, vent.; P. Newman, vent.; Mark Meyer, vent.; DeLacy & Co., vent.; Prince & Whitney, vent.; Potter, Lovell & Co., vent.; International Hotel, rest; Merritt's Rest., rest.; Harris Bros., vent.; J. B. Kleinert, s. machs (shields); Hallenberg & Lowenstein, s. machs., neckties; H. H. Ward & Co., s. machs., furs; Van Lien & De Forrest, looms, silk; Vocalion Organ Co., organs; U. S. Supply Co., pump; Union Special Sewing Machine Co.; F. B. Starr, jeweler; J. Stock, rest.; G. H. Pell, organ; Park, Davis & Co., vent.; Metropolitan Life Ins. Co., vent.; A. Mander, jeweler; A. Levy & Bros., s. machs., buttons; R. Loeb, s. machs., underwear; E. Hurley, organ; Franklin Photo. Elect. Co., pump blower; Domestic Sewing Machine Co., s. machs.; J. H. Clark, s. machs., corsets; Crichton & Co., printing; Consolidated Pat. Shirt Co., s. m., shirts; L. S. Cox & Co., s. m., jerseys; G. A. Castor & Co., s. m, clothing; A. Benjamin & Co., s. m., clothing; American Exchange National Bank, vent.; L. Achtelstatter, rest.; Benedict Bros., jewelers.

This makes a total of 300 motors, distributed in 115 installations. Of these motors 260 are ⅛ h. p., 8 of ¼, 19 of ½, 6 of 1, 2 of 2, 1 of 3 and 2 of 5.

The New York Safety Steam Power Company.

The above company, of 30 Cortlandt street, have just supplied two 50 h. p. engines to William Donaldson, the well known dry goods merchant of Memphis, Tenn., for his large store, in which he has installed an extensive Edison incandescent and American arc plant. The company have also supplied the Columbus Electric Light Company with three more engines of 100 h. p. This makes the Columbus Company's fifth order. The Pratt Institute, of Brooklyn, have just put in a 125 h. p. horizontal safety engine and a 20 h. p. vertical. The demand for their vertical engines is very good among electric lighting companies, one having been recently shipped to the Thomson-Houston plant at Memphis, Tenn., and one to the Brush Company, for a search light outfit on the steamer "Gardner," at Lacrosse, Wis. Mr. Copeland reports also an order just received from Albany, Ga., for a 100 h. p. horizontal engine, with boiler, for the new Edison station there.

The Excelsior Electric Company.

The above company has secured an order for a plant of 200 arcs and 500 incandescents for the city of Orange, N. J. The contract was obtained by Mr. R. H. Sherwood. The Excelsior Company's large isolated plant of 60 arc lights at Brighton Beach is winning very favorable comments from the visitors to that popular resort. It has also a plant of 20 arc lights at the depot in Brooklyn, and 36 at the Coney Island of Culver's R. R. These are good pieces of installation, and give great satisfaction. The management of the company inform me that the decision in favor of the Thomson-Houston Company against the American, with regard to the dynamo regulator, virtually settles also the case of the Excelsior Company against the American in favor of the former.

The Eickemeyer Dynamo.

J. H. Bunnell & Co., Liberty street, report a brisk demand for Eickemeyer dynamos and motors, and find it difficult to keep up with their orders. The firm were never so busy before at this season of the year, and are sending their specialties and regular lines of goods to all points of the compass.

The Empire City Electric Company.

This company, of 15 Dey street, are extremely busy on every line of their specialties. The business of the concern has steadily increased and extended, until they are manufacturers and dealers in telephone, telegraph, electric light, electric power and other electrical supplies of every description. Among the articles for which they report a brisk demand at the present time are their electric bell pulls, wood push buttons, metal buttons, wood box bells, iron box bells, skeleton bells, disque battery for open circuit work, dynamo gas lighters, annunicators and burglar alarms. The company have also a growing business in insulators, pins, brackets and cross-arms, and are now disposing of very large quantities of bare and insulated wires and cables. Altogether their business is as varied as it can well be. In every department they report briskness and activity.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
178 Devonshire Street, Boston, Aug. 20, 1888.

Personals.

Mr. C. R. Truex, of the New York Electrical Accumulator Company, was in this city last week, and was the guest of Mr. John T. Moriarty at the Boston Electric Club.

Mr. Geo. W. Davenport, manager of the executive office of the Thomson-Houston International Electric Company, returned to Boston Thursday, Aug. 16, after a fortnight's vacation in Maine.

Motor Cut Motor.

A humorous point of the close competition between rival motor companies is illustrated by the fact that in Boston at the present time a motor, manufactured by one of the prominent companies, is operating a lathe upon which the commutators of a rival firm are being turned down.

Framingham Electric Railway.

Advices from South Framingham, Mass., under date of Aug. 15, report that arrangements were perfected that afternoon by the citizens of Saxonville for a banquet and jollification on the evening of Wednesday, Aug. 22, which will be held in Athenæum Hall, in connection with the opening of the Saxonville Division of the Framingham Union Street Railway (electric), which event occurs on that day. A free ride will be given the citizens of Saxonville, Aug. 22, and cars will leave that village for South Framingham at 4 P. M.

Thomson-Houston Motors.

Mr. H. C. Spaulding, the Eastern representative of the Motor Department of the Thomson-Houston Company, informs us that he has disposed of three 10 h. p. motors in Boston within a week past, besides a number of smaller sizes. Especial interest is being manifested at present by electric railway companies in the installation of stationary power circuits in connection with the railway system, and, in a recent conversation, Mr. Spaulding cited one case of a company which is paying all the running expenses of the road out of the profits of the stationary power system, thus making all the income from passengers a source of clean profit to the company.

Armington & Sims Engine.

The Jarvis Engineering Company, of Boston, reports having received an order from the East Side Street Railway Company, of Brockton, Mass., for an Armington & Sims engine of 135 horse power. This engine will be used in the street car company's steam plant for furnishing power for the electric cars.

Thomson-Houston Electric Railways.

Some idea of the amount of electric railway business which is being done by the Thomson-Houston Electric Company may be gained from the fact that the company has been obliged to add two new buildings to its present factory at Lynn, Mass. At the present time there are 16 roads in operation using the Thomson-Houston system, and the following will give an idea of those which have just been completed, or are in process of construction. The Seattle Electric Railway and Power Company is the name of a corporation in Seattle, Washington Territory, which is composed of the Seattle Street Railway Company, and the West Street, Lake Union & Park Transit Company. These two companies, which own the most valuable railway system and control the most valuable franchise in Seattle, have decided to unite their interest and to equip their entire system with electricity. In order to determine the best system to use, Mr. F. H. Osgood, president of the former company, and Dr. E. C. Hilbourne, vice-president and acting president of the latter company, have made an exhaustive examination of the various roads and systems in use at present and have contracted with the Thomson-Houston Electric Company for the equipment of their road, believing that their system is superior in every respect. The road which is to be in operation Jan. 1, is four and one-half miles in length, 3,000 feet double track, and will operate five cars. It will be in all respects a model road. The tracks for the electric railway at Bangor are now being laid. The Street Railway Company has decided to use electricity and has made a contract with the Thomson-Houston Company for a complete equipment. The road, which will use the single overhead conductor, is two miles long, and will operate ten cars, each equipped with a 20 h. p. Thomson motor. The single car which has been for some time in operation at Crescent Beach was turned over to the Lynn & Boston Street Railway Company, Aug. 1, and since that time has been in charge of men formerly employed on horse cars. It has

run thus far without a hitch of any kind and is said by the driver to be much easier to operate than the ordinary horse car. The cars have been largely patronized by excursionists to Ocean Pier and have been found by them to be a great convenience.

The Des Moines Broad Guage Railway Company is to equip its seven and one-half miles of track with the Thomson-Houston system, and will operate eight cars having the latest improved trucks. The Omaha & Council Bluffs Railway and Bridge Company will put in a model road using the Thomson-Houston system. The overhead construction will be used, the trucks containing all the latest improvements. This road which is two miles long, and on which four cars will be operated, will be one of the finest electric railways in the United States. It will be in operation by Sept. 15.

The overhead construction work at Syracuse is now completed and the cars will be in operation very soon. The road is four miles in length and will have eight cars. The Suburban Street Railway of Scranton received about two weeks ago an improved motor truck from the Thomson-Houston Electric Company. This was put in operation on the 5th inst. and since that time has been running successfully, climbing the heavy grades at such speed and with such ease that it leaves no doubt in the minds of the most prejudiced observer that the motors are perfectly adapted for this class of work and are abundantly able to do all that is claimed for them. Two more Thomson-Houston trucks will be added very soon, and it is the intention of the company to have ten new trucks before long. The Nay-Aug Cross-Town Railway, of Scranton, will add four of the improved Thomson-Houston trucks, which will be put in operation this month. Work on the machinery of the Hoosac Valley Street Railway, at North Adams, is being rapidly pushed forward. The road will be equipped under the Thomson-Houston system, using the single overhead conductor and return rail circuit. The track is five miles long and six cars will be operated. The Lynn & Boston Street Railway Company have taken a good deal of interest in the electric railway at Crescent Beach, and have been careful observers of the construction and operation. Their investigation has been of such a satisfactory nature that they have unanimously decided to adopt the Thomson-Houston system for the Highland Line at Lynn. This line will give the Thomson-Houston Company an excellent opportunity to show the excellence of their system, especially in curve construction, as the road has a large number of curves, and grades as high as 9 per cent. In spite of these facts, the directors anticipate the best results from the use of this system. The road will be in operation early in September, and will use the single overhead conductor and return rail circuit. The Revere Street Railway has come to a settlement of its differences with the Boston, Revere Beach & Lynn Railroad, which had caused considerable delay in the work of construction. The track construction was completed Aug. 15, and the electrical work on the 16th, and cars are now running regularly.

Among the many points of superiority in the Thomson-Houston system may be mentioned the under running trolley, the motor brushes and the use of lightning arresters. The trolley arm, unlike those in use on other systems, is so made that at whatever height the conductor may be above the car the trolley will always maintain an even pressure upon it. This will be found to be of great advantage whenever it is desired to run under a low bridge or to cross railroad tracks where the conductor is necessarily suspended very high. The brushes used in the Thomson-Houston motor are self-feeding, and but one pair is required for each motor. There is no change required in the brushes for change of load or change in direction of the rotation of the armature. They are said to be the only brushes used in railway motors which do not cause sparking at the commutator. The Thomson-Houston system is also said to be the only one in which lightning arresters are used. They are an absolute protection from lightning and had they been in use on some roads, which we have seen, the loss of three or four motors would not have occurred.

The Jarvis Engineering Company.

This company has of late received several orders from street railway companies to equip steam plants for furnishing power to run electric cars, and it is the intention of the Jarvis people to give this line of business their especial attention in the future. Among the orders recently filled by this company were the following: The Crescent Beach, Mass., Electric Railway, Thomson-Houston system; the Meriden, Conn., Electric Railway, Daft system, and the Syracuse, N. Y., Electric Railway, Sprague system. The Jarvis Company is now at work on steam plant No. 1 of the West End Street Railway Company's electric road, Sprague system, Boston, Mass.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., Aug. 18, 1888.

Washington, D. C.

A dispatch from Washington says: "Mr. J. F. Powell, the inspector of electric lights for the Treasury Department, has been designated by the House Committee on Public Buildings and Grounds to prepare plans and specifications for the electric lighting of the House side of the Capitol and for supplying an electric call bell plant.

The Standard Flint Glass Works,

of which Mr. Wm. Kuemmerle, Jr., is the owner and manager, have been compelled, on account of the immense increase in their business, to seek more commodious quarters to display samples of their goods, but, fortunately, they were able to secure the desired space in the building in which they have so long been located, No. 1207 Arch street. The high grade of work turned out by this establishment has been the means of bringing to them a goodly share of the incandescent bulb trade, as well as that in other glass goods used in electric lighting, and with increased facilities both at the factory and show rooms, they will be in much better shape to meet the heavy demands upon them.

The Edison Station.

The Edison Company, whose mammoth building is going up at a rapid rate, are receiving a large number of applications for incandescent service in the business portion of the city, and by the time their new station, with a capacity of more than 80,000 lights, is completed, it is probable they will be crowded. The Associated Press were among the first applicants, looking, as they invariably do, to the comfort of their employés.

Alfred F. Moore.

In the last Philadelphia notes, by a slip of the pen, it was stated that Mr. Moore was now manufacturing three tons of insulated wire and cable per week. It should obviously have read "per day," but I hasten to make the correction and to do justice to Mr. Moore's large and growing business.

Street Railways in Washington.

The House of Representatives at Washington has spent the better portion of two days in discussing the question of overhead electrical conductors for street railways, and the Committee on the District of Columbia affairs has been instructed to report a bill making it unlawful for the Commissioner of the District to grant permits for the erection of such wires. The point in question was the projected street railway to run to the suburban districts to the new Catholic College, taking in the Soldiers' Home, and which it was proposed to equip with the overhead system. All the prominent senators took part in the discussion as to the danger of overhead wires, and the general disposition seemed to be to do away with all aerial lines, both telegraph and telephone wires being included.

E. W. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, Aug. 18, 1888.

Noiseless Gearing for Motor Cars.

An order for four blocks of rawhide has just been received by the Chicago Rawhide Manufacturing Company, of this city, to be manufactured into gearing for use on motor cars. It is claimed that rawhide manufactured in this way makes a noiseless gearing, and at the same time has the wearing qualities of steel.

Packing for High Speed Engines.

Some three or four months ago, Mr. B. W. Goodsell, the manufacturer of fibrous packing, placed some of his goods on the engines running the West Side electric light plant. He informs me that it has been in constant use since that time, making 270 revolutions per minute, and is in the best of condition, there being no leakage of steam. The wearing body of the packing is made of braided Russian flax having an elastic rubber back securely attached by vulcanization, and although it has been on the market but something over a year, Mr. Goodsell informs me that it is now being used on some of the largest plants in the country. The manufacturer specially recommends it for electric light engines.

Carbon Troubles.

The subjoined is from the Cleveland papers:

A petition filed with the clerk of the Court of Common Pleas Monday by the Standard Carbon Company against W. H. Boulton, relates the following alleged facts: On the 9th of July, 1887, the Boulton Carbon Company, the Cleveland Carbon Company and the Crystal Carbon Company entered into an agreement whereby they formed the Standard Carbon Company, with a capital stock of $500,000. During the first year of the company's existence W. H. Boulton was its general manager on a salary of $3,000 a year. Last Saturday the directors of the company held their first annual meeting and re-elected as directors W. H. Boulton, Mrs. W. H. Boulton, D. A. Dangler, J. B. Crouse, W. G. Smith, and H. A. Tremaine. All the directors qualified save Mrs. Boulton, who was not present. The directors then proceeded to an election of officers, which resulted as follows: D. A. Dangler, president; J. B. Crouse, vice-president; W. G. Smith, secretary and treasurer; H. A. Tremaine, superintendent. No general manager was elected, it having been decided to dispense with that office. W. H. Boulton is a large stockholder in the Standard Carbon Company, owning nearly one-half of the stock. In consideration for his stock he contributed at the time the company was formed a lease which he then had of the premises on which the factory is situated at the corner of Hamilton street and the Cleveland & Pittsburgh Railway crossing. This lease has still two years to run. The corporation went into immediate possession with Mr. Boulton's approval and co-operation. A large property of great value was put into the factory, and the company has been in possession of the premises ever since, and has paid rent therefor, but has never received a formal assignment of the lease, as its applications made from time to time have been neglected. Monday morning when the superintendent went to the factory to start the day's work Mr. Boulton, who was there, refused him entrance, declared himself in possession and served the following written notice:

"*Standard Carbon Company:*

"GENTLEMEN: Desiring to use the premises occupied by you, corner of Hamilton street and Cleveland & Pittsburgh crossing, I have taken possession of the same and you are hereby requested to remove your property therefrom forthwith. I am, as you know, the lessee of said premises, and am entitled to the exclusive possession thereof. W. H. BOULTON."

The company says that the plant is worth $50,000 and the good will of the business depends on the prompt filling of orders and that the defendant threatens to throw the machinery into the street if it is not removed. It is asked that he be perpetually restrained from interfering with the business and that the lease be granted to the company. Judge Noble issued a restraining order and set the case for hearing Aug. 20.

The Chicago Edison Plant.

The new central station plant of the Chicago Edison Company was first put in operation on Tuesday of this week, some 900 lights having been turned on. A force of men is kept busy connecting up other lights as fast as possible, from two to three hundred being turned on each day. The machinery is all in place and the huge dynamos are running very smoothly. The company are confident the plant will be running to its full capacity within a few days. This, when complete, will be the largest central incandescent station in the West.

A Correction.

Among recent installations reported in my correspondence of Aug. 4, was one credited to the Thomson-Houston Company for Menominee, Wis. It should have been Menominee, Mich., instead. The Excelsior Company have the plant in Menominee, Wis.; no other electric light plant being in that place.

Running a Factory by Motor.

The Ritchie Paper Box Factory, occupying six floors, and located on Michigan avenue, is being run by a Thomson-Houston 15 h. p. motor. The motor is located in the basement, and power is transmitted from a line of shafting on each floor. An elevator which is used in carrying freight up to a ton weight is also operated by the motor.

Personal.

Mr. David Chalmers, of the Empire City Electric Company of New York, was in the city this week, and made this office a pleasant call. Mr. Chalmers is making a business trip in this section in the interests of his company.

Mr. James R. Dee, of Houghton, Mich., was in the city last week on business. Mr. Dee informs me that he and his company are contemplating putting up an incandescent plant to be operated in connection with their arc plant.

Mr. D. B. Stedman, Jr., of the Thomson-Houston Company, returned from his Eastern trip last week. He reports electrical matters very active with his company in the East. The electric railway, electric welding, and other special departments are being put in shape as fast as possible for the turning out of apparatus.

Salinas City, Cal.

An electric light company was recently organized in this city and has just ordered 30 Thomson-Houston arc lights. The plant will be operated as a central station.

Omaha and Council Bluffs.

The Omaha & Council Bluffs Electric Railway Company will put in a plant of 20 arc lights to be operated in connection with the electric road of the Thomson-Houston system, the franchise for which was recently granted, mention of which I made some weeks ago. The lamps have just been ordered from the Thomson-Houston Company.

Peoria, Ill.

The Royal Electric Company, of Peoria, has been incorporated with a capital stock of $10,000. Incorporators: James W. Smith, Gustav A. Schaeffer and Charles W. Robinson.

New Corporations.

The following companies have been granted licenses of incorporation by the Secretary of State:

The Electrical Accumulator and Lighting Company, of East St. Louis, capital stock $250,000. Incorporators: William L. Hill, Charles Sutter and William S. Rogers.

Citizens' Electric Company, at Collinsville, capital $100,000. Incorporators: S. W. Baird, S. P. Baird and M. T. Baird.

Electric Date and Time Stamp Company, at East St. Louis, capital $1,000,000. Incorporators: William H. Stevenson, Henry H. Wernse, James B. Johnson, J. M. Thomson and Hamilton L. Daughaday.

The American Telephone Sonoretta Company, Chicago; capital stock, $50,000; incorporators, Charles S. Clark, George L. Lavery, F. S. Baker, Charles W. Morehouse and N. W. Hartwell.

The Electric Health Drink Company, Chicago; capital stock, $350,000; incorporators, Clemens Plager, Christ Weihrman and H. A. Richter.

Crude Petroleum for Fuel.

The piped crude petroleum which it is predicted is to become so useful and important to manufacturing interests and which was started from Lima, O., several days ago, reached South Chicago on Tuesday morning of this week. The pipe through which it is forced is made of wrought iron, eight inches inside diameter and was constructed to stand the pressure of 1,000 pounds to the square inch. The length of the line, which extends from Lima, O., to a point on the Lake Shore about a mile south of Calumet harbor, is 206 miles. Tanks to be used in storing the fluid have a capacity of 35,000 barrels each, there being five in number, two of which are now completed and the others will be finished inside of thirty days. An immense pumping engine is required at Lima to force the oil through the pipe, which it does at the rate of 8,000 barrels a day. Crude petroleum as a fuel is in extensive use in many cities and has been tried successfully here. In time it is hoped to pipe the oil all over the city, but at present tank cars will be used to supply the demand. The cars will be filled at the tanks at South Chicago, running on the Belt Line and delivered to all parts of the city. A barrel of Lima oil, which cannot be refined like other oil, is supposed to be equal to a ton of coal as far as results are concerned. At Lima it is used, among other things, to supply prime power for the electric railway.

Telephone Quotations.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$150@	$155	Iowa Union	$27@	$28
Central Union	47@	48	Michigan	79@	80
Chicago	340@	345	Missouri and Kansas	70@	71
Colorado	44@	47	Rocky Mountain Bell	40@	45
Cumberland	65@	68	Wisconsin	110@	112
Great Southern	35@	40		E. L. P.	

KANSAS CITY, Aug. 18.

Electric Railways in the West.

The establishment of an electric railway is about to be undertaken in this vicinity. This second effort is across the river and across the State line in Kansas, in Kansas City, Kan. Mr. Jas. D. Husted, a real estate dealer, who has made everything else go that he undertook, is at the head of the company as president; W. L. Wood is secretary; L. H. Wood, treasurer. These officials are also directors, the other members of the directory being C. F. Hutchins, E. J. Camp, T. H. Rowland and O. R. Burnham.

The line will be an extensive one, passing entirely through the town on Minnesota avenue, one of the main thoroughfares, and reaching out to several of the suburbs. The company proposes to construct a road similar to lines in operation in Richmond, Va., Scranton, and Alleghany, Pa., and now under construction in Boston. The line will also connect with the Fifth street and Wyandotte cable line of the Metropolitan Railway Company, of Kansas City, Mo.

The franchise has been granted by the Council of Kansas City, Kan., and requires that underground wires shall be used when they become practicable; that the road shall be completed within

eighteen months; that flagmen shall be stationed at all crossings where the city authorities may deem necessary; that cars shall run from 5:30 A. M. to 12 o'clock midnight, at intervals of not more than ten minutes; that a tax of $12.50 shall be levied on each car every six months; and that the company shall give a bond of $5,000 for compliance with the provisions of the ordinance.

Should the operation of electric railways prove as successful and profitable as that of cable railways, look out for several electric lines in Kansas City, Mo. Only the other day one of the leading officials of the Metropolitan Company said to me: "The company is waiting only to see that the electric lines now in operation in the different parts of the United States prove successful during the winter, and when convinced that the system is no experiment, and that these roads can be operated successfully, we will immediately build in Armourdale or on the Southwest Boulevard to Rosedale, and perhaps both. It is the intention of the company to investigate the matter thoroughly and if the results as claimed by the roads in Allegheny City and Richmond can be accomplished, we will be satisfied." He didn't say, but it was unnecessary, that if the system was a success, the Broadway line of the company, which could easily be made the most profitable line, and whose grades are the least of any line in the city, would also be converted into an electric line. Meantime all the electrical agents and companies are being besieged with inquiries from all over the country concerning electric railways. The Board of Public Affairs of Cincinnati has granted the Consolidated Street Railway Company a franchise for an electric railway along Colerain avenue. The Des Moines Electric Railway Company will push things and have its cars running earlier than at first expected. Electric cars will soon be running in Davenport, Iowa; a company with a capital stock of $20,000 has been formed at Columbus, Ind., for building an electric road; the new electric road in San Jose, Cal., has just entered upon successful operation; the Springfield, Mo., electric line will soon be in operation the Union electric line of St. Joseph, Mo., is declared to be a success by its operators; the Frederick avenue and the Citizens' companies of the same city have consolidated for the purpose of converting their combined seven miles of horse railway into an electric motor line, while the Wyatt Park Company, of the same city, has already let the contract to the Sprague Company for the equipment of its line with electric motors. K. C. M.

ENGLISH NOTES.

LONDON, Aug. 8, 1888.

Scientific Assessors in Courts of Justice.

In connection with the recent patent litigation, an article which appeared last week in *Nature*, entitled "Scientific Assessors in Courts of Justice," has attracted some attention in legal and scientific circles. The writer points out that by virtue of an Act of Parliament, passed in the year 1873, the judge has power to call in one or more "assessors," who shall sit with him upon the bench, and whose duty it would be to assist the judge in arriving at a decision with regard to the technical features of the case. This system has long been followed in our Admiralty Courts, where two of the elder brethren of the Trinity House are always present to give the judge the benefit of their knowledge and experience in all matters relating to navigation. The suggestion is one which could hardly fail to benefit litigants and effect a considerable saving of time and money in the hearing of such suits. The difficulty would of course arise in selecting competent and impartial men for the position, but inasmuch as their duties would be limited to answering such questions as the judge might place before them, and they would not be required to acquaint themselves with law as well as science, it is probable that the difficulty might easily be overcome. That some reform of this character is urgently required is admitted on all sides.

Electrolytically-Formed Copper Steam-Pipes.

Lloyds' committee have recently had under their consideration the question of the use copper steam-pipes under the high pressures which are now commonly employed with marine engines. Numerous cases of accident, not infrequently of a fatal character, have occurred through the bursting of such pipes, which usually takes place along the line of brazing. Mr. W. Parker, the chief engineer surveyor to Lloyds, was requested by the committee to investigate and report upon the seamless, electrolytically deposited copper pipes recently introduced by Mr. Elmore, of Cockermouth. His report has just been issued, and is of such a highly favorable character that it is by no means improbable that Lloyds will shortly forbid the employment of any other kind of pipe for steam pressurse exceeding a limit, which will possibly be fixed at 120 lbs. Elmore's process is of a very interesting character. The copper is deposited upon an iron mandrel which rotates in a tank containing copper sulphate, with unrefined Chili bars as anodes. In front of the iron mandrel an agate burnisher or planisher is supported upon suitable arms and levers, and presses lightly upon the surface of the copper. As the mandrel revolves the burnisher is caused to traverse it from end to end, so that every particle of copper deposited passes through this process of burnishing. The result is that the metal, instead of taking the form of large crystals visible to the naked eye, such as are usually formed in the electrical deposition of copper, acquires an extraordinarily fine and dense texture, which possesses both tenacity and ductility in a remarkable degree. Comparative tests were carried out by Mr. Parker upon three descriptions of copper, electrolytically deposited by Elmore's process, solid drawn and rolled, and the tenacity was found to be 23¾, 20¼ and 14 tons per square inch, respectively. Its remarkably high ductility is shown by the fact that the elongation is chiefly confined to the neighborhood of fracture, and whereas the contraction of area at the fracture in the solid drawn copper is 12.8 per cent., and in the sheet copper 45 per cent., in the deposited copper it averages 72 per cent. These experiments were also repeated at high temperatures, with results of an equally favorable character.

Dr. Oliver Lodge on Lightning Conductors.

Dr. Oliver Lodge has a very remarkable paper in this month's *Philosophical Magazine*. He has calculated out the frequency of the oscillations of a lightning discharge, and finds that it is of the order of one million reversals per second. The results which follow are of a singularly interesting character. Without entering into the mathematical reasoning, I may just say that it is proved that the impedance of a conductor may be expressed to a high degree of approximation by the simple formula $\sqrt{\frac{L}{S}}$; where L is the self-induction and S the capacity. The reason of this extraordinary simplification of the formula is to be found in the fact that when the rate of alternation becomes so large, all those terms which are not multiplied by n or powers of n become negligible in comparison. This result emphasizes the conclusion which Dr. Lodge had already arrived at, that by far the most important point to be attended to in a lightning conductor is to increase the capacity in the highest possible degree and at the same time to diminish self-induction. It would, however, be a mistake to suppose that the resistance is of no importance, because the above formula only relates to cases in which the discharges are of an oscillatory character, and theoretically it is quite possible that the conditions present may sometimes be such as will permit a lightning flash to take place in one direction only. In such cases the resistance of the conductor again becomes important. Curiously enough there is some evidence of an experimental nature which lends itself to the belief that the oscillatory discharge is by far the more common form. In the year 1764 lightning conductors were attached to the dome of St. Paul's cathedral and were put up under the advice of the Royal Society. Communication was made with the leaden roof, which has a superficial area of some 30,000 square feet, and consequently possesses enormous capacity. Many years afterward, during some repairs to the cathedral, it was discovered that the conductor had been accidentally broken at some point about half way down, and was no longer in metallic connection with the ground. The fact, therefore, that under these conditions the dome had so long experienced immunity from damage by lightning, would almost serve to show that the great capacity of the conductor had compensated for the introduction of a very high resistance. Whether or not it had ever actually received a lightning discharge while in this state there is no evidence to show; but considering that the cross at the top of the dome is the highest point within an area of a good many square miles it is scarcely possible that in a long series of years it could have altogether escaped. In concluding this paper Dr. Lodge says that his investigations on the liability to side-flash have led him to suppose that, provided sufficient capacity can be obtained, it may after all be the best way to insulate the conductors entirely from the building. The great interest which is being taken in this subject at the present moment has led the Organizing Committee of the British Association to arrange for a discussion upon the subject at the Bath meeting in September. The discussion will be opened by Mr. W. H. Preece, and Dr. Lodge will, of course, take part. There can be no doubt that a highly interesting and instructive debate will ensue.

The United Telephone Company.

The United Telephone Company, feeling the pressure of public opinion, have lately been making endeavors to meet the demands upon them. A week or two since they announced that the exchange service would be open night and day, including Sundays, and it is now stated that they will shortly open the existing call rooms to the public on the payment of a small sum. At present these call rooms, which probably number ten or a dozen, are nominally open to subscribers only; but as a matter of fact a considerable use is made of them by people wishing to talk with their friends who are on the exchange, consequently the concession is more apparent than real.

The City and the Electric Light.

I understand that the question of lighting the city by electricity will shortly again come before the authorities, and as the Maxim-Weston Company is hardly in a position at the present time to act the part of dog in the manger, which they have so successfully performed hitherto, there is now every reason to anticipate a good result.

THE TELEGRAPH.

District Telegraphs.—A suit has been brought by the Western Electric Company against the New Haven Clock Company in the United States Circuit Court at Hartford, Conn., for alleged infringement of district telegraph signal box devices.

American Telegraphs.—A dispatch from the City of Mexico of Aug. 14, says: The Mexican Telegraph Company today announced that it would raise its rates to Europe on Sept. 1. This action is taken in consequence of the increase in rates by the Atlantic cable companies.

THE TELEPHONE.

Akron, O., has the telephone rate fever. The instruments are wanted at $3 per month.

Oakland, Cal., is to employ the telephone in connection with its police patrol system.

The Clambake of the Year.—Invitations have been issued by Mr. Eugene Phillips, president, for the tenth annual clambake given to the electrical fraternity by the American Electrical Works. The bake will be held at the Vue de l'Eau Club, near Providence, on Sept. 1; lunch at 11:30, and the bake to open at 3. The reception committee are H. C. Davis, F. A. Gilbert, A. C. White, J. I. Sabin, E. B. Baker and W. H. Sawyer.

THE ELECTRIC LIGHT.

Natchez, Miss.—The bids for city electric lighting will be received by the Mayor until Nov. 1.

Pittsburgh, Pa.—The Pittsburgh Power Company will, it is said, put in an Edison plant for lighting the South Side.

La Grange, Ga.—The La Grange Oil Mill and Manufacturing Company are to put an electric light plant in their factory.

Marquette, Mich.—Bids are invited on the electric light plant for the State House of Correction and Branch Prison at Marquette, Mich. Details will be found in our advertising columns.

Ingersoll, Ont.—The Reliance Electric Light Company, of Waterford, has contracted for city lighting, at 25 cents per light per night.

Richmond, Va.—The city has under consideration the purchase of a Brush plant of 120 arcs of 2,000 c. p., and 25 miles of circuit, for $35,000.

Little Rock, Ark.—Mr. W. O. Thomas reports that the Edison Company at Little Rock will start a plant of 1,000 lights by the beginning of October.

Eau Claire, Wis.—The city of Eau Claire has accepted a proposal from the Brush Electric Company to light the city for five years at the rate $110 per light per year.

Brooklyn, N. Y.—The Electric Light Company, 106 Broadway, Brooklyn, E. D., N. Y., will erect a two-story brick station, 75 × 80, on Rodney street, corner of Ainslie street.

Vancouver, Wash. Ter.—The Vancouver Electric Light and Power Company has been incorporated by W. E. Matson, D. Wall, C. Brown and others, with a capital stock of $15,000.

St. Louis, Mo.—The Electrical Accumulator and Lighting Company of East St. Louis, Ill., has been formed by W. L. Hill, C. Sutter and W. S. Rogers, with a capital stock of $250,000.

Manchester, N. H., has voted for 200 arc lights on its streets, and Mr. A. B. Griggs, of the Thomson-Houston Company, is now making the arrangements necessary for carrying out the contract by the Manchester Electric Light Company.

San Francisco, Cal.—The bid of the California Electric Light Company (Brush system for public lighting at 55 cents per night for 2,000 c. p. lights and $4.40 for 16,000 c. p. lights, passed the Board of Supervisors recently and was referred to the Committee on Gas Light.

Dover, N. H.—It is rumored that the Dover (N. H.) Electric Light Company proposes to run wires from Buffam's mills, Great Falls, to South Berwick, Me., Salmon Falls, Dover, Rochester and East Rochester, having recently purchased a water-power at Great Falls.—*Manchester Union.*

St. Joseph, Mo.—John J. Hogan, mechanical engineer, 87 Centre street, New York, has been appointed consulting engineer for the heating and electric lighting of the St. Joseph court-house and jail. The work includes about 13,000 square feet of radiating surface and some 250 lights.

A Reviving Wire.—A story appeared a few days ago in the papers to the effect that one of the linemen of the Hartford, Conn., Electric Light Company was killed by a shock from a wire, but that in falling from the pole he struck another wire and received a second shock, which at once brought him to life again.

Amesbury, Mass.—The Amesbury Electric Light Company are putting in a special circuit to run motors, to be installed by Mr. E. W. Goss, their electrician. The company has just declared a half yearly dividend of 3 per cent., and is about to put up a fine new station 40 by 60 feet, two stories high, with room for about ten dynamos

Columbus, S. C.—The plant of the Congaree Gas and Electric Light Company will consist of 60 Thomson-Houston arc lights. Some city lights have already been contracted for, and the remainder will be taken by private parties. The plant, which will be in operation by Oct. 1, has been supplied by Mr. G. B. Edwards, president of the Charleston, S. C., Light and Power Company.

Costa Rica.—Mr. H. N. Curtis, New York agent for the Thomson-Houston Company, has just closed a contract for a 100 light plant for San Jose, the capital of Costa Rica, Central America. It is to be operated by water power, and will light all the streets of the city. The syndicate to whom the sale was made have the government concession and adopted the system after a careful inquiry by Mr. Luis Batres, one of their number.

Ogdensburg, N. Y.—Mr. J. H. Findlay, of the Ogdensburg Gas Company, has bought from the Wheelock Engine Company, of Worchester, Mass., a 150 h. p. condensing engine to run the electric light plant in that place. An order has been given to the Campbell Electrical Supply Company of Boston for 20 miles of "Vulcan" line wire for the plant, and the same company has an order for five miles for H. H. Mills & Co. for a plant at Whitisburn, N. Y.

Chattanooga, Tenn.—Since the consolidation of the Hauss and Brush Electric Light Companies the plant of the former, which will operate all the incandescent lights, has been undergoing repairs, and is now complete in every respect, and the machinery will be put in motion at once. A fuel gas furnace has been added to this plant, which will decrease considerably the item of fuel. They have a capacity of 2,000 lamps and a power large enough to make every lamp satisfactory.

Milwaukee, Wis.—The Badger Illuminating Company, which commenced business in this city Jan. 1, 1888, have one of the most complete and best equipped plants in their part of the country. They are now running six dynamos of the Thomson-Houston pattern, and are furnishing light to their full capacity, besides supplying motor power to a shoe factory and a job printing office. The city now pays for about 150 lights, and as many more are under immediate contract. The company expect to largely increase their capacity this fall.

Nearly 1,000,000 Leather Links Used.—Chas. L. Ireson, manufacturer of Ireson's self-adjusting leather link belting, 97 High street, Boston, Mass., reports obtaining the two largest orders ever given for link belting, namely, through Mr. C. L. Edgar, manager, belts for the entire station of the Edison Electric Illuminating Company, Head Place, Boston, as follows: 14 12-inch link belts, each 43½ feet long; total length, 609 feet; weight, 2,436 pounds; number of links required, 334,950. Also through Mr. John I. Beggs, vice-president and general manager Edison Electric Illuminating Company, New York City, a full order for belting new station in New York City as follows: 16 15-inch link belts, each 48 feet long; total length, 768 feet; weight, 3,840 pounds; number of links used in its construction, 528,000, making a grand total of 862,950 leather links required to produce these belts.

Hoosick Falls, N. Y.—Mr. John T. Sawyer formerly superintendent of the Consolidated Electric Light Company of

Portland, Me., is now in charge of the electric light plant at Hoosick Falls, where he hopes to have 60 street lights running by the 20th. The engines and boilers are set, and the electrical apparatus is all on the ground. Mr. Sawyer is also making an addition of 11 lights for the Bennington, Vt., Electric Light and Power Company and is giving an eye to the work of the Athol, Mass., Electric Light and Power Company.

APPLICATIONS OF POWER.

Knoxville, Tenn., proposes to have an electric road running to Beaman's Lake.

Danvers, Mass.—The authorities at Danvers have approved of the petition of the Beverly & Danvers Street Railway Company for permit to use electricity as a motive power on its road.

Another Pennock Scheme.—News comes from Chattanooga, Tenn., as to a project that Mr. Pennock proposes to float, of a company to transport mail matter, etc, in tubes by electricity long distances. If the idea amounts to anything it is well to remember that other inventors have been at it for some time.

Dayton, O.—Mr. Elmer P. Morris reports the successful starting, under his supervision, of the White Line Electric Street Railway at Dayton, O. The start was made on Aug. 8, and 10 cars are now in operation, carrying a large number of passengers, and working very smoothly. The Thomson-Houston system is used.

Newport, R. I., is to have a street railroad. The corporators have organized by the choice of Joseph P. Cotton, L. D. Davis, A. C. Titus, J. Truman Burdick and Henry H. Fay as directors. Judge Darius Baker has been engaged as counsel, and it is expected to have a part of the proposed line in operation before winter. Electricity will probably be used as a motive power.

Lewiston, Me.—An electric motor is in successful operation for wood sawing in Lewiston, Me. It is of six horse-power, and with a 26 in. saw, which was driven at a velocity of 1,450 revolutions per minute, a cord of slabs was sawed in 20 minutes. The proprietor claims that with a six horse-power electric motor he can do more work than with a ten horse-power steam engine.—*Mfrs. Gazette.*

Minneapolis, Minn.—The Edison Electric Light and Power Company has been organized at Minneapolis, Minn., as already announced, with a capital of $500,000. The incorporators are T. B. Walker, Henry C. Akeley, Charles H. Chadbourn, S. G. Cook and W. W. Huntington, of Minneapolis, and Willard H. Churchill, of New York, who constitute the first board of directors. President Johnson, of the Edison Electric Light Company, and also president of the Sprague Motor Company, is also negotiating for the introduction of that motor in Minneapolis. The new company will furnish the motive power from its central station for the cars on the electric railway.

PERSONALS.

Mr. H. C. Davis, president of the New York Electric Club, who returned recently from Europe, was given a "welcome home" dinner at the club-house on Aug. 16, by thirty or forty of his friends and leading members. The dinner was worthy the occasion, and we understand that a most delightful evening was spent.

Mr. Joseph B. Stearns, of duplex telegraph fame, is described in an interesting article in the Lewiston, Me., *Journal*. He began to earn his living when 8 years old, and was from the first noted for a prodigious memory. It is said that at his beautiful villa farm of 500 acres at Camden, Me., he has gathered a library of 10,000 volumes and many choice pictures.

John Lester Murphy is Queen Victoria's private telegrapher. He travels about with her and has nothing to do but attend to her telegraphic dispatches. His position is practically a sinecure. The Queen never dictates to him directly, but sends her messages to him by a secretary. The Queen admires Murphy. Not long ago at Windsor she remarked that he was "the only man of sense in the house." As the Prince of Wales and Henry of Battenberg were in the mansion at the time, Murphy felt quite flattered.—*N. Y. World.*

MISCELLANEOUS NOTES.

The Gibson Electric Company, of New York City, has been incorporated with a capital stock of $10,000.

The Phonograph in England.—Another very successful exhibition of the phonograph has been made in England by Col. Gouraud.

Phonograph at a Reunion.—A special dispatch from Concord, Mass., says: The fifth annual reunion of the Hartwell family, which will take place in Concord on the 30th inst., is to have an interesting feature, which by its novelty will attract attention. An Edison improved phonograph is to be exhibited by Prof. George H. Hartwell, and it is expected that the phonograph will record various remarks and addresses, and repeat them at some future occasion.

BUSINESS NOTICES.

Hine & Robertson, of 45 Cortlandt street, this city, are making the offer to sell their No. 3 Kellam damper regulator, the price of which is $125, for electric light stock of par value of $100. This is a novel proposition, which ought to be taken up.

Jordan & Gottfried, 208 Canal Street, N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

The Fishkill Landing Machine Company, of Fishkill-on-the-Hudson, N. Y., are meeting with great success in the sale of their improved Fishkill-Corliss engine. This engine embraces in its construction many attractive improvements destined to make it extremely popular for electric light purposes.

The Okonite insulated telegraph and telephone wires and cables manufactured by the well-known Okonite Company of this city continue to grow in popularity. Large quantities of their wire have been used by the Western Union and other telegraph companies for aerial and underground purposes with the greatest success.

The Abendroth & Root Safety Boiler is becoming very popular for electric lighting stations. Its safety and economy of fuel, with its quick generating power, and the ease and dispatch with which examinations and repairs can be made to the water tubes, make it especially valuable for electric light purposes.

The Partz Electric Battery Company, of Philadelphia, having found their old quarters at 1,723 Chestnut street too small, have leased the large building at 636 Arch street, same city. They are now prepared to fill all orders promptly, and in addition to their large line of Open Circuit and Gravity and Motor Batteries, have a full line of small Motors and Dynamos. Send for their price list and catalogue, or write to them stating what you want.

Rubber Goods.—An endless variety of rubber goods in various styles may be seen at the warehouse of the New York Belting and Packing Company, 15 Park Row, New York. Their goods are known all over the world, and they stand in the front rank of successful manufacturers of vulcanized rubber goods for mechanical purposes. The company report a brisk demand for their machine belting with smooth metallic rubber surface for use on dynamos and swift running machinery.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

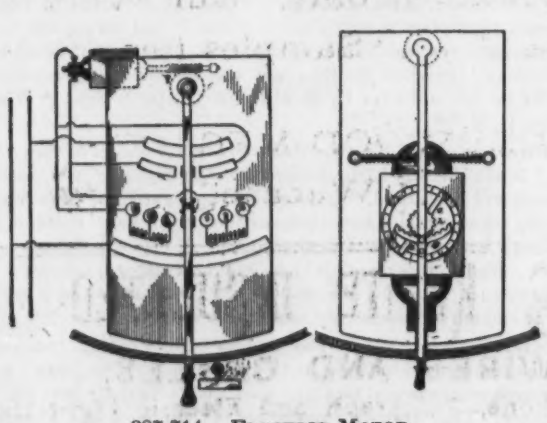
PATENTS ISSUED AUGUST 14, 1888.

387,636. Mechanical Telephone; Manious Garl, Canton, Ohio. Application filed Oct. 24, 1887. The diaphragm is parallel to the line and is connected therewith by an adjustable link, by which tension is put upon the line and upon the diaphragm, and is thrown entirely off the diaphragm.

(1) 387,642, (2) 387,643. Galvanic Batteries; Ernest M. Hewett, Boston, Mass., Assignor to Hiram G. Farr, of same place. Applications filed Nov. 17 and 21, 1887, respectively. A dry battery in which the cell is filled with infusorial earth, saturated with an acidulated solution.

(1) 387,645, (2) 387,888, (3) 387,889, (4) 387,890. Multiple switch-Boards; Milo G. Kellogg, Hyde Park, Ill. Applications filed respectively May 26, 1887; May 21, 1887; June 6, 1887, and Aug. 25, 1887. These inventions embrace among other things a novel construction of spring jack switch. They also include a system of operation on exchange and testing at one board to determine whether any given line is in use at any other board.

387,654. Jar for Galvanic Batteries; Bernard Overlack, Boston, Mass., Assignor to the Overlack Elastic Composition Company, of Saco, Maine. Application filed April 28, 1888. A containing jar composed of white sand, resin, slaked lime, boiled linseed oil, sulphuric acid and sub oxide of copper.



387,714. ELECTRIC MOTOR.

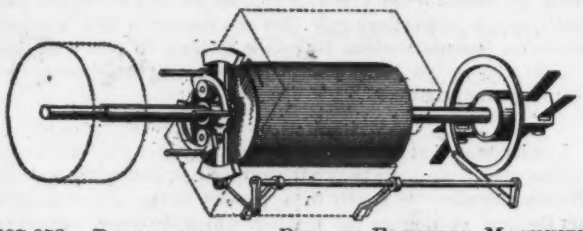
387,670. Electrolyte for Galvanic Batteries; D. H. Fitch, Cazenovia, N. Y. Application filed Jan. 19, 1888. Muriatic or chlorhydric acid in connection or combination with the solution for galvanic batteries, made by dissolving chloride of ammonium and chlorate of potassium or chlorate of sodium together in water.

387,703. Circuit Closer for Electric Clocks; Charles D. Warner, Ansonia, Assignor to the Standard Electric Time Company, of New Haven, Conn. Application filed May 7, 1888. Owing to the wear of journals in clocks, it sometimes happens that a good contact is not made between the wheel and its shaft. This invention contemplates the use of a brush which bears upon the wheel itself and takes off the current.

387,704. Electric Clock System; Chas. D. Warner, of Ansonia, and Arthur D. Bennett, of New Haven, Conn., Assignors to the Standard Electric Time Company, of New Haven, Conn. Application filed May 7, 1888. An alarm circuit is provided for the purpose of giving notice when the apparatus is inoperative by reason of waste of battery, or otherwise.

387,714. Electric Motor; B. A. Fiske, of the United States Navy. Application filed Jan. 17, 1888. This is a motor which is controlled by hand to move such objects as gun carriages and railway turn tables, which have limited movements. The design is such that the motor will rotate faster or slower in exact accordance with the movement of the hand in operating the controlling device. See illustration.

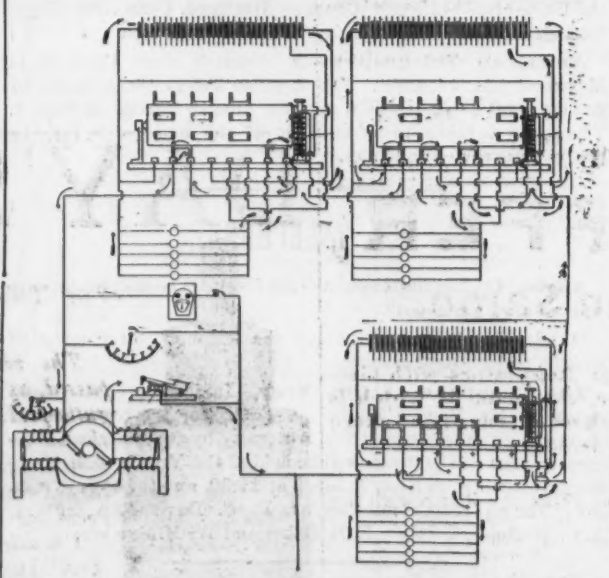
387,718. Telephone Support; Newton W. Hartwell, Louisville, Ky. Application filed April 4, 1888. A lever connected



387,853. REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

with the telephone box by a universal joint, and carrying at its outer end a frame for supporting the receiver, and also acting as a sound insulator.

387,732. Electric Cut-Out; Joseph A. Powers, Lansingburg, N. Y. Application filed June 19, 1888. This is a "snap" switch in which the spring controlling the movable element is brace shaped and adapted to be compressed by the movement



387,988. APPARATUS FOR CHARGING AND DISCHARGING SECONDARY BATTERIES.

of the handle in either direction and to force the handle into its extreme positions. See illustration.

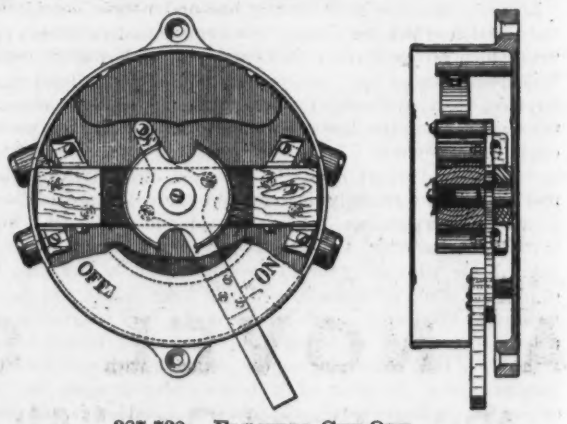
387,839. Galvanic Battery; Granville T. Woods, Cincinnati, O. Application filed July 9, 1887. Carbon pencils are supported in an annulus around the outside of a cylinder of hard rubber which is open at both ends. The zinc is suspended centrally from the cover, inside of the cylinder.

387,853. Regulator for Dynamo-Electric Machines; Charles L. Buckingham, of New York, N. Y., and Hermann Lemp, of Hartford, Conn. Application filed June 21, 1887. The object of the invention is to employ the movement of a magnetic bar placed under the control of the lines of magnetic force to shift or adjust the commutator-brushes to a non-sparking position. The brushes are first properly adjusted for a certain electrical condition of the machine, when the magnetic bar is mechanically joined to the brushes. Thereafter, with each displacement of the magnetic bar, the brushes will be correspondingly changed and adjusted to a non-sparking position. See illustration.

387,992. Flash Light Signal; William H. Thompson, Richmond, Ind. Application filed April 19, 1887. An incandescent lamp is used in circuit with a relay and circuit-closing key. The lamp is made to give flash lights to indicate fire-alarm signals.

387,969. Insulation for Mechanical Telephone Conductors; Francis E. Clark, New York, N. Y., Assignor, by direct and mesne assignments, of one-fourth to Chas. A. Hess and W. J. Townsend, of same place. Application filed June 22, 1888. The line at the point where it comes in contact with its support is covered with or rests against felt.

387,974. Electric Clock Synchronizing System; Charles J. Hexamar, of Philadelphia, Pa., Assignor to the



387,732. ELECTRIC CUT-OUT.

Philadelphia Time Telegraph Company, of same place. Application filed Jan 10, 1887. A long-distance synchronizing system in which the line is composed of a series of adjacent sectional circuits, whose ends are alternately connected to relay magnets and armatures.

387,988. Apparatus for Charging and Discharging Secondary Batteries; M. Pfatischer, of Philadelphia, Pa., Assignor of one-half to Wm. T. Brown and William Kirk, Jr., both of same place. Application filed Nov. 18, 1887. This invention contemplates the operation of each independent battery, at will, from the central station. Rotatable cylinders having electrical contacts for cutting the batteries into the charging circuit, and additional contacts for cutting the lamps into the battery circuit, are located at each outlying station, and are controlled from the central generating station. See illustration.

(1) 388,003, (2) 388,004. (1) Meter for Alternating Electric Currents; (2) Method of Measuring Alternating Electric Currents; Oliver B. Schallenberger, Rochester, Pa. Applications filed June 6, 1888. For description see page 94, this issue.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, N. Y.